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The use-wear studies on the lithic industries

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CHAPTER 2

The use-wear studies on the lithic industries

(É. Claud, C. Thiébaut, A. Coudenneau, M. Deschamps, C. Lemorini, V. Mourre, F. Venditti)

1 - Sampling and study method

With the exception of Les Pradelles, the lithic industries from the sites included in the research project were the subject of use-wear analyses. For Les Pradelles, functional data was nonetheless available concerning the material from the older excavations (Beyries, 1987a, 1988a).

The sampling methods, the composition of the samples, and the number of pieces analyzed varied according to the sites and the use-wear analysts, due to different issues encountered. A global analysis was favoured whenever the archaeological levels were well identified (Mauran, Saint-Césaire, Les Fieux, Chez-Pinaud, Bayonne le Prissé PM1) or whenever an interdisciplinary approach was possible (Grotte du Noisetier). Despite significant stratigraphic issues, other assemblages included specific tool types, whose analysis could allow their eventual specific function to be identified (Abri Olha, El Castillo, Payre). Finally, the sampling of certain assemblages was guided by the time allocated to the use-wear analysis or by issues specific to a certain tool type (La Conne de Bergerac, La Graulet, Combe Brune 2, Gatzarria, Bayonne le Prissé PM2). For Fonseigner, only the flint tools benefited from a global analysis. It is clear that the analysis of the quartz and quartzite remains from this assemblage could contribute important additional information to our understanding of the technical methods used by the occupants of this site in the processing of plant and animal resources.

For the majority of the assemblages, a global study of the industry was carried out (unretouched blanks, retouched tools, and cores, see table 47). The best-preserved pieces and those with a high functional potential were often selected. In the case of Chez-Pinaud, Fonseigner, Grotte du Noisetier and Saint-Césaire, two observation stages were carried out: the detailed analysis phase was preceded by an initial examination of a very large number of pieces at low magnification (stereomicroscope), to look for possible macroscopic use-wear traces, to assess the state of preservation of the assemblage, and to select the pieces best suited for use-wear analysis. In the case of the industries from Mauran and Les Fieux, the different pieces were examined with a stereomicroscope, with the exception of any debris, small flakes (excluding retouching and resharpening flakes) and small fragments.

The use-wear analyses conducted at Abri Olha, Gatzarria, El Castillo, Combe Brune 2, La Conne de Bergerac, La Graulet and Payre only involved one typo-technological category: flake cleavers for the former three sites, bifaces for the following three sites, and points for the latter site. Although a global analysis of the assemblages from Combe Brune 2, La Conne de Bergerac, La Graulet and Gatzarria would be worth carrying out in the future, a global analysis would be of little relevance for the other assemblages given the stratigraphic context of the levels concerned.

In total, nearly 10 000 pieces were observed under a stereomicroscope and a little more than 2 000 pieces were subject to a use-wear analysis. Except for the industry from Coudoulous, for which only the quartz and quartzite pieces were analyzed due to the very poor state of preservation of the flint pieces, the samples of analyzed pieces included a diverse range of materials used by the Neanderthal groups: flint, quartz, quartzite, sandstone-quartzite, ophite, schist, lydite and cinerite. For the latter two materials, as no comparative reference collection was available, we used the criteria for determining macro-traces established for flint. Indeed the grain fineness of these

	Total number of pieces in the lithic collection	Topic of the study	Sample modalities	Number of analysed pieces	Number of pieces with use-wear traces	Number of pieces with undeterminate traces	Number of pieces with micro-use-wear traces	Preservation state of the sample	Post-depositional modifications	Remarques
Abri Olha I (Fi 3)	253	flake cleavers	all flake cleavers	83	6	8	0	intermediate to bad	rounding, crushing, small scars	difficulties to identify traces due to soft and medium hard material (hide-working, butchery…) on several pieces
Abri Olha II (askf1)	2902	flake cleavers	all flake cleavers	5	1	0	0	intermediate to bad	rounding, crushing, small scars	difficulties to identify traces due to soft and medium hard material (hide-working, butchery…) on several pieces
Bayonne le Prissé (PM1)	969	global approach	tools and unretouched flakes with functional possibilities	~ 200	11	7	2	good to intermediate	bright patina	dry flint, on which micro-polishes seem to be less developed
Bayonne le Prissé (PM2)	1336	test	tools and unretouched flakes sampled for drawings	~ 50 (10 precisely analysed)	6	5	0	good to intermediate	white patina, bright patina, rounding	difficulties to identify traces due to soft material (hide-working)
Chez-Pinaud (US 06/07)	3638	global approach	all, excepted debris and chunks	~ 3000 (497 precisely analysed)	144	52	50	good to intermediate	bright patina, scars, bright spots	/
Combe Brune 2 (61000)	5	bifacial tools	all bifacial tools	5	1	3	0	intermediate	bright patina, rounding	/
Coudoulous 1 (couche 4)	132 (flint), 2713 (quartz), 1340 (quartzite)	global approach	quartz pieces (the best preserved ones)	79	62	-	53	good	scars, fractures, bright spots	/
El Castillo (couche Alpha)	681 (tools)	flake cleavers	all flake cleavers	284	24	9	0	intermediate to bad	rounding, crushing, small scars	difficulties to identify traces due to soft and medium hard material (hide-working, butchery…) on several pieces
Gatzarria (niveau Cjr)	3636	flake cleavers	all flake cleavers	7	2	0	0	intermediate to bad	rounding, crushing, small scars	difficulties to identify traces due to soft and medium hard material (hide-working, butchery…) on several pieces
Fonseigner (Dsup)	1661 (flint industry) + 406 (pebble industry)	global approach (flint only)	all, excepted debris, chunks and cores	~ 1200 (98 precisely analysed)	40	0	33	good	white and bright patinas (light)	4 bifaces lost thus unstudied
La Conne de Bergerac	752	bifacial tools	all bifacial tools	5	2	1	0	intermediate	white et bright patinas, rounding, thermal damage and cracks	/
La Graulet 3	440	bifacial tools	all bifacial tools	5	2	0	0	intermediate	white et bright patinas, rounding, thermal damage and cracks	/
Grotte du Noisetier	3531	global approach	all, excepted debris and chunks	2150 (116 precisely analysed)	25	49	1	intermediate to bad	scars, rounding, bright patina, crystal erosion	pieces from the inner part of the cave are very badly preserved, they cannot be studied
Les Fieux (couche K)	1164	global approach	tools and unretouched flakes with functional possibilities	219	51	15	-	good to intermediate	bright patina, scars	under-estimation of soft material processing (cutting hide or meat for example) + several pieces very bad preserved that could not be studied)
Mauran (XV 2 / couche 2)	3189	global approach	tools and unretouched flakes with functional possibilities	172	58	13	-	good to intermediate	bright patina, scars	under-estimation of soft material processing (cutting hide or meat for example) + several pieces very bad preserved that could not be studied)
Payre (couche G)	701	points	triangular pieces	113	40	10	0	bad	intense white patina, scars	several pieces with pseudo-retouch
Saint-Césaire (niveau Egpf)	46974 (10427 studied)	global approach	tools and unretouched flakes with functional possibilities	1983 (166 precisely analysed)	93	31	0	good to intermediate	bright patina, scars, bright spots	under-estimation of soft material processing (cutting hide or meat for example) + several pieces very bad preserved that could not be studied)

Table 47 - Methods for studying the different assemblages included in use-wear analyses.

rocks most likely gives them a wear behaviour comparable to that of flint. To analyze the schist, we used the reference collection for quartzites (in particular those with fine grains) as well as some experimental pieces used as part of the research project, but which have not been presented in this volume due to the lack of a sufficiently comprehensive reference framework.

The state of preservation of the working edges and surfaces varied in terms of how favourable they were to analysis and did not always allow any use-induced micro-traces to be observed. Thus the microscopic approach could only be applied to the assemblages from Chez-Pinaud, Coudoulous and Fonseigner, and to a lesser extent, to those from Bayonne le Prissé PM1 and Grotte du Noisetier. This lead to differences in the precision of the interpretation of the materials worked, both between the assemblages and within the assemblages, notably: the hardness of the materials (macroscopic traces) versus the exact nature of the materials (macroscopic and microscopic traces). No assemblage was free from natural alterations (see table 47). For the flake cleavers, which were the most obvious example of a possible taphonomic filter, the state of preservation of the majority of pieces did not allow us to identify traces produced by the cutting and scraping of soft or even medium-hard materials (for example, the cutting up of carcasses or the scraping of wood). For most of the other assemblages, it is possible that some of the more tenuous use-wear traces, such as those related to the working of soft materials over a short time (for example, the cutting of hide or meat without any contact with the bone), were not preserved or were not distinguishable from taphonomic background noise (such as a slight rounding of the working edges). Some activities could thus have been underestimated: the cutting of dry and fresh hide, the scraping of fresh hide, the cutting of non-woody plants, or even light butchery activities, such as the cutting of meat without any contact with the bone.

2 - Results

As the data obtained on the function of the pieces are particularly numerous and the criteria for interpreting the use-wear traces were discussed in Part I, we shall not describe the traces present on the archaeological material in detail, aside a few exceptions. Instead we shall directly present the results of our interpretations, first in terms of the mode of use (worked material, movement and prehension mode), and then in terms of activities. Nevertheless, numerous photographs of both macroscopic and microscopic traces, grouped by activity, have been provided to support our use-wear interpretations (figures 172-188).

A - General statistics

A total of 568 pieces and 613 active zones presented signs of use-wear, to which we can add a zone with prehension marks from Coudoulous (contact with leather). A further 141 zones not included in this total presented traces whose characteristics were not sufficiently diagnostic to be reliably interpreted as use-wear traces (table 47). Finally, five pieces bore traces that could have been produced by hafting, but not all the identification criteria (see Rots, 2002a, 2004, 2010) were present (see Part I, chapter 2.5). All the data concerning the different types of function identified in relation to the assemblages has been documented in Annex 5. The active zones for which the interpretations are reliable have been differentiated from the "possible" or "doubtful" zones, that is to say, from the zones with traces that could not be clearly distinguished from natural traces (potential cutting of soft to medium-hard material but possibly natural traces, for example). Question marks have therefore been used in the tables to make it easier to identify them (tables 48-49).

B - Types of action identified

Different types of action were identified (tables 48-49).

Globally, longitudinal actions were the most documented (45 %). They corresponded, in the case of soft material such as hide or meat, to cutting, and for more resistant material, to sawing or even grooving, although the nature of the gesture could not always be established. In these cases, the general term of longitudinal action was used (see tables 50-51). Percussion (23 %) was relatively common, but it was dominated by the percussion of mineral material, related to knapping activities and the production of tools (n=93 / 139). These pieces do not therefore directly concern the acquisition or exploitation of plant and animal resources, like the other pieces used in other types of action on mineral material (scraping and friction with tool surface, 28 pieces). Although included in the general figures, and having already been the subject of several publications (Thiébaut, 2005; Claud, 2008, Thiébaut *et al.*, 2010; Claud *et al.*, 2010; Sorensen, Claud, 2016), they will not be included in our discussion in the following paragraphs and tables (see table 49 for figures without mineral substances).

Transverse actions, often grouped together for convenience under the term "scraping", were less common (17 %). Piercing was little observed in the assemblages (4 %), neither were intermediary pieces and mixed actions (less than 1 % and 4 % respectively).

Finally, with regard to hunting weapons, apart from two triangular quartz flakes from Coudoulous presenting diagnostic microscopic traces, none of the pieces presented any macro-traces characteristic of such use (Part II, chapter 2.4). Nonetheless, four pieces presented traces compatible with this type of function but they were not considered sufficiently diagnostic: a convergent side scraper from Chez-Pinaud, two retouched flint flakes from Les Fieux and a quartzite pseudo-Levallois point from Mauran (see Part II, chapter 2.4).

C - Identified worked material and attempt at interpretation of activities

The apparent diversity in the materials worked (see table 50) is due to the scarcity of microscopic traces (allowing the precise determination of the worked material), leading to the creation of categories of material corresponding to different degrees of hardness: soft, soft to medium-hard, medium-hard, ...

Let us begin by considering only the pieces for which the precise nature of the worked materials could be determined, most of which presented micro-traces, totaling 119 in number (left-hand side of table 51). Butchery activities involving meat and hide processed by cutting, sometimes associated with scraping (Coudoulous), represented 62 % of the worked materials.

Hide working represented 27 % of the active zones (cutting, scraping, or both), while only 9 % of the active zones presented evidence of woodworking (scraping and sawing).

In terms of the points used for hunting weapons, a little less than 2 %, corresponding to two quartz flakes from Coudoulous, presented diagnostic microscopic traces, in association with fractures (Part II, chapter 2.4).

There were 494 active zones presenting only macroscopic use-wear traces, providing us information on the hardness of the materials worked (right-hand side of table 50). However, 121 of them concerned mineral material, so the number of zones that interested us directly was reduced to 373.

Of these 373 active zones, 19 % were used to work soft materials, particularly through cutting actions, with occasional pieces having been used for scraping and piercing.

These soft materials could have involved meat, hide, or non-woody plants. However, the characteristics of the edge damage present on the active zones that were used to cut were very similar to those present on the experimental pieces that cut meat without any contact with the bone.

	Longitudinal motion (cutting, sawing…)										Transversal motion (scraping)								Percussion (chopping)						Cutting + scraping		Cutting + percussion			Intermediate piece (wedge, gouge)		Piercing					Impact (hunting)	Friction	Undetermined action				Prehension traces		Undeterminate traces (use or alteration?)	Total of active zones
	Hide	Meat	Meat or hide	Wood	Soft	Soft to medium hard	Medium hard	Medium hard to hard	Hard	Undetermined	Hide	Wood	Soft	Medium hard	Medium hard to hard	Hard	Hard and mineral	Undetermined	Medium hard	Medium hard to hard	Hard and undeterminate	Hard and organic	Undeterminate (medium hard to hard)	Hard and mineral	Meat	Hide	Medium hard	Medium hard to hard	Hard and organic	Undeterminate	Medium hard	Soft	Soft to medium hard	Medium hard	Medium hard to hard	Hard	Carcass	Hard and mineral	Soft	Soft to medium hard	Medium hard	Medium hard to hard	Hafting scars	Hide wrapping		
Abri Olha I (Fi 3)																			1 + 2?			4 + 2?	1 + 4?																					**6 + 8?**
Abri Olha II (Askf1)																							1																					**1**
Bayonne le Prissé (PM1)						10 + 3?																		3													2						**4**	**15 + 7?**
Bayonne le Prissé (PM2)						4 + 2?									1									1																			**3**	**6 + 5?**
Chez-Pinaud (US 06/07)	14	15+ 1?	15 + 1?		43+ 3?	17 + 1?	2	2						5	1	4	3		1 + 1?	1		2		17 + 1?			1	1		1	1					1?	17	3	1	4		1?		**1**	**171 + 10?**
Combe Brune 2 (61000)					1 + 1?									1?					1?																									**1 + 3?**
Coudoulous (layer 4)	1			5	2		3		1		2	6		7		3									26												2			5	1		1		**64**
El Castillo (layer Alpha)																			3 + 7?			9	12 + 2?																					**24 + 10?**
Gatzarri (level Cjr)																			1				1																					**2**
Fonseigner (Dsup)	6	14	3		5	8	1				6			1		1	2									1										1						3?			**49 + 3?**
La Conne de Bergerac 3			1		1														1?																									**2 + 1?**
La Graulet 3																			2																									**2**
Grotte du Noisetier					2?	16 + 28?		1 + 2?			1			1?	2?	2?				1?		1?		3 + 2?			1?	1									3	1?	1 + 4?	2?	1			**2**	**27 + 51?**
Les Fieux (couche K)					5	12	1		1	1				6		21						1											1		3		2?								**52 + 2?**
Mauran					5	23	4			1	1			6	3	9		1															1		2		1?								**57 + 1?**
Payre (layer G)						5	6	1					1	7		3																2	1	11	1									**10**	**38**
Saint-Césaire (level Egpf)					2	16 + 20?								5?	2 + 1?	2?				2 + 4?	1	3		69																	1 + 1?					**96**
Total of active zones (uncertain mode of use with "?")	**21**	**29 + 1?**	**19 + 1?**	**5**	**64 + 6?**	**109 + 54?**	**17**	**4 + 2?**	**2**	**2**	**10**	**6**	**1**	**32 + 7?**	**7 + 3?**	**41 + 4?**	**5**	**1**	**8 + 12?**	**3 + 5?**	**1**	**19 + 3?**	**15 + 6?**	**93 + 3?**	**26**	**1**	**1**	**1 + 1?**	**1**	**1**	**1**	**2**	**2**	**3**	**14**	**2**	**2 + 5?**	**23**	**3 + 1?**	**2 + 4?**	**10 + 3?**	**2**	**-**	**-**	**20**	**613 + 141?**
Total of active zones with an uncertain interpretation of use or that are undeterminate (traces due to use or alteration?)	**0**	**1**	**1**	**0**	**6**	**54**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**7**	**3**	**4**	**0**	**0**	**12**	**5**	**0**	**3**	**6**	**3**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**0**	**1**	**4**	**3**	**0**	**-**	**-**	**20**	**141**
Total of active zones with clear mode of use	**21**	**29**	**19**	**5**	**64**	**111**	**17**	**4**	**2**	**2**	**10**	**6**	**1**	**32**	**7**	**41**	**5**	**1**	**8**	**3**	**1**	**19**	**15**	**93**	**26**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**3**	**14**	**2**	**2**	**23**	**3**	**2**	**10**	**2**	**-**	**1**		**614**
Total of active zones per action	**274**										**103**								**139**						**27**		**3**			**2**		**23**				**2**	**23**	**17**							**613**
% of active zones per action	**44.7**										**16.8**								**22.7**						**4.4**		**0.5**			**0.3**		**3.8**				**0.3**	**0.7**	**2.8**							

Table 48 - Number of active zones by site, according to the modes of action, including traces of undetermined origin and active zones used to work mineral materials.

	Longitudinal motion (cutting, sawing…)										Transversal motion (scraping)								Percussion (chopping)						Cutting					Intermediate piece (wedge, gouge)		Piercing					Impact (hunting)	Friction	Undetermined action				Prehension traces		Total of active zones	Total of active zones without mineral material
																									+ scraping		+ percussion																		
	Hide	Meat	Meat or hide	Wood	Soft	Soft to medium hard	Medium hard	Medium hard to hard	Hard	Undetermined	Hide	Wood	Soft	Medium hard	Medium hard to hard	Hard	Hard and mineral	Undetermined	Medium hard	Medium hard to hard	Hard and undeterminate	Hard and organic	Undeterminate (medium hard to hard)	Hard and mineral	Meat	Hide	Medium hard	Medium hard to hard	Hard and organic	Undeterminate	Medium hard	Soft	Soft to medium hard	Medium hard	Medium hard to hard	Hard	Carcass	Hard and mineral	Soft	Soft to medium hard	Medium hard	Medium hard to hard	Hafting scars	Hide wrapping		
Abri Olha I (Fi 3)																			1			4	1																				6	6
Abri Olha II (Askf1)																							1																				1	1
Bayonne le Prissé (PM1)						10																		3													2							15	10
Bayonne le Prissé (PM2)						4									1									1																			6	5
Chez-Pinaud (US 06/07)	14	15	15		43	17	2	2						5	1	4	3		1	1		2		17			1	1		1	1						17	3	1	4				171	134
Combe Brune 2 (61000)					1																																						1	1
Coudoulous (layer 4)	1			5	2		3		1		2	6		7		3									26												2			5	1		1	64	64
El Castillo (layer Alpha)																			3			9	12																				24	24
Gatzarri (level Cjr)																			1				1																				2	2
Fonseigner (Dsup)	6	14	3		5	8	1				6			1		1	2									1											1							49	46
La Conne de Bergerac 3			1		1																																						2	2
La Graulet 3																			2																										2	2
Grotte du Noisetier						16		1			1													3				1									3		1		1			27	21
Les Fieux (layer K)					5	12	1		1	1				6		21						1												1										52	52
Mauran					5	23	4			1	1			6	3	9		1																1		2		1							57	57
Payre (layer G)						5	6	1					1	7		3																			2	1	11	1							38	38
Saint-Césaire (level Egpf)					2	16									2					2	1	3		69																		1				96	27
Total of active zones	**21**	**29**	**19**	**5**	**64**	**111**	**17**	**4**	**2**	**2**	**10**	**6**	**1**	**32**	**7**	**41**	**5**	**1**	**8**	**3**	**1**	**19**	**15**	**93**	**26**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**3**	**14**	**2**	**2**	**23**	**3**	**2**	**10**	**2**			**613**	**492**
Total per action	**274**										**103**								**139**						**27**		**3**			**2**		**23**				**2**	**23**	**17**						**613**	
% per action	**44.7**										**16.8**								**22.7**						**4.4**		**0.5**			**0.3**		**3.8**				**0.3**	**0.7**	**2.8**						**97**	
Total without mineral material	**21**	**29**	**19**	**5**	**64**	**111**	**17**	**4**	**2**	**2**	**10**	**6**	**1**	**32**	**7**	**41**		**1**	**8**	**3**	**1**	**19**	**15**		**26**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**3**	**14**	**2**	**2**		**3**	**2**	**10**	**2**			**492**	
Total per action without mineral material	**274**										**98**								**46**						**27**		**3**			**2**		**23**				**2**		**17**						**492**	
% per action without mineral material	**56**										**20**								**9**						**5**		**1**			**0.4**		**5**				**0**		**3**							

Table 49 - Number of active zones by site, according to modes of action, excluding traces of undetermined origin and active zones used to work mineral materials.

	AZ with an interpretation of a precise material worked (n=119)									AZ with an interpretation of the hardness of the material worked (n=373, without mineral material)																												Total
	Hide			Meat		Meat or hide	Carcass	Wood		Soft				Soft to medium hard			Medium hard							Medium hard to hard						Hard and organic					Hard undet.	Undet. but medium hard to hard	Undetermined			
	Cutting	Scraping	Mixed	Cutting	Cutting + scraping	Cutting	Hunting	Longitudinal motion	Scraping	Cutting	Scraping	Piercing	Undetermined	Cutting	Piercing	Undetermined	Longitudinal motion	Scraping	Percussion	Piercing	Intermediate piece	Mixte	Undetermined	Longitudinal motion	Scraping	Percussion	Piercing	Mixed	Undetermined	Longitudinal motion	Scraping	Percussion	Piercing	Mixed	Percussion	Percussion	Longitudinal motion	Scraping	Intermediate piece	
Abri Olha I (Fi 3)																			1													4				1				**6**
Abri Olha II (Askf1)																																				1				**1**
Bayonne le Prissé (PM1)														10																										**10**
Bayonne le Prissé (PM2)														4												1														**5**
Chez-Pinaud (US 06/07)	14			15		15				43			3	17		1	2	5	1		1	1	4	2	1	1		1			4	2						1	**134**
Combe Brune 2 (61000)										1																														**1**
Coudoulous (layer 4)	1	2			26		2	5	6	2							3	7					5						1	1	1	3								**64**
El Castillo (layer Alpha)																			3													9				12				**24**
Gatzarri (level Cjr)																			1																	1				**2**
Fonseigner (Dsup)	6	6	1	14		3				5				8			1	1														1								**46**
La Conne de Bergerac 3						1				1																														**2**
La Graulet 3																			2																						**2**
Grotte du Noisetier		1												16		1								1						1				1							**21**
Les Fieux (layer K)										5		1		12			1	6								3			1	21	1					1			**52**
Mauran		1								5		1		23			4	6		2				3						9		1				1	1		**57**
Payre (layer G)											1			5	2		6	7		1				1			11			3		1							**38**
Saint-Césaire (level Egpf)										2				16									1		2	2					3			1					**27**
Total	**21**	**10**	**1**	**29**	**26**	**19**	**2**	**5**	**6**	**64**	**1**	**2**	**3**	**111**	**2**	**2**	**17**	**32**	**8**	**3**	**1**	**1**	**10**	**4**	**7**	**3**	**14**	**1**	**2**	**2**	**41**	**19**	**2**	**1**	**1**	**15**	**2**	**1**	**1**	**492**
Total per material worked	**32**			**74**			**2**	**11**		**70**				**115**			**72**							**31**						**65**					**1**	**15**	**4**			**492**
% per material worked	**6.5**			**15.0**			**0.4**	**2.0**		**14.3**				**23.4**			**14.7**							**6.3**						**13.2**					**0.2**	**3.1**	**0.8**			**99.9**
% within each degree of accuracy of interpretation (precise material worked *versus* hardness)	**27**			**62**			**2**	**9**		**19**				**31**			**19**							**8**						**17**					**0**	**4**	**1**			

Table 50 - Number of active zones per site, according to material worked, excluding traces of undetermined origin and active zones used to work mineral materials.

	Wood processing					Animal material processing											Undetermined activities							Total
	Woodworking (longitudinal motions)	Probable woodworking (longitudinal motions)	Woodworking (scraping)	Probable woodworking (scraping)	Probable woodworking (percussion)	Hunting points	Butchery / cutting (+ scraping at Coudoulous)	Probable butchery (cutting)	Butchery, cutting (non micro-polish)	Probable heavy butchery (cutting)	Probable heavy butchery (percussion)	Probable butchery (cutting and percussion)	Hide working (cutting)	Hide working (scraping)	Probable hide working (piercing)	Hide working / mixed action (cutting and scraping)	Scraping of a hard and organic material (bone?)	Undetermined activity (cutting)	Undetermined activity (scraping)	Undetermined activity (piercing)	Undetermined activity (intermediate piece)	Undetermined activity (percussion)	Undetermined activity (mixed motion)	Undetermined activity / undetermined motion	
Abri Olha I (Fi 3)					1						4											1			**6**
Abri Olha II (Askf1)																						1			**1**
Bayonne le Prissé (PM1)									10																**10**
Bayonne le Prissé (PM2)									4										1						**5**
Chez-Pinaud (US 06/07)		2		5	1	1?	30	43	17	2	3	1	14				4		1		2		1	8	**134**
Combe Brune 2 (61000)								1																	**1**
Coudoulous (layer 4)	5	3	6	7		2	26	2		1			1	2			3							6	**64**
El Castillo (layer Alpha)					3						9											12			**24**
Gatzarri (level Cjr)					1																	1			**2**
Fonseigner (Dsup)		1		1			17	5	8				6	6		1	1								**46**
La Conne de Bergerac 3							1	1																	**2**
La Graulet 3					2																				**2**
Grotte du Noisetier									16	1		1		1										2	**21**
Les Fieux (layer K)		1		6		2?		5	12	1	1				1		21	1		3					**52**
Mauran		4		6		1?		5	23					1	1		9	1	4	3					**57**
Payre (layer G)		6		7					5	1							3		1	15					**38**
Saint-Césaire (level Egpf)								2	16		5								2			1		1	**27**
Total	**5**	**17**	**6**	**32**	**8**	**2 + 4?**	**74**	**64**	**111**	**6**	**22**	**2**	**21**	**10**	**2**	**1**	**41**	**2**	**9**	**21**	**2**	**16**	**1**	**17**	**492**
Total per activity	**68**					**2**	**279**						**34**				**41**	**68**							**492**
% per activity	**14.0**					**0.5**	**56.7**						**6.9**				**8.3**	**13.5**							**100**

Table 51 - Number of active zones by site, according to the activities identified, excluding traces of undetermined origin and active zones used to work mineral materials.

The lack of rounding, which is characteristic of the working of hide, also supports the hypothesis of their use in light butchery.

In contrast, the wear associated with piercing, consisting of scars and edge rounding, was more likely to have been produced by the working of hide.

The scraping of soft material, identified on one piece, could not be related to any specific activity.

The working of soft to medium-hard materials was the most common, involving 31 % of the active zones. These materials were mainly processed by cutting, or very occasionally, piercing. The macro-traces consisted of scars that were very similar to those observed on the experimental pieces used in butchery, in which the working edges were used to cut soft materials such as meat, tendons and skin but occasionally touching more resistant material such as bone or cartilage.

The working of medium-hard material involved 19 % of the active zones. Various types of action were documented: in decreasing order of frequency, we identified scraping, longitudinal actions (sawing and incision), direct percussion, piercing, indirect percussion and mixed actions.

In the case of the longitudinal, transverse and percussion actions, the scars were characteristic of working a material of similar hardness to wood. The most likely hypothesis is therefore that these pieces were used for woodworking, although we cannot draw any firm conclusions.

The pieces used for piercing sometimes presented rounding indicating their probable use on rigid, and therefore dry, hide. These different pieces cannot be easily related to a specific activity, even if some of them appear more likely related to woodworking and others to hide working.

Similarly, the rare tools used in a mixed mode of action or as an intermediary piece on medium-hard material, did not allow any interpretation in terms of activities.

The working of hard organic material involved 17 % of the active zones. A large part of them were used for scraping (41 out of 65), followed by percussion (19).

Given the scarcity of bone tools in the Middle Palaeolithic, traces related to the scraping of hard organic materials could correspond to contact with bone material during the butchery process in the broader sense, to remove meat from the bone or to scrape the periosteum. Nevertheless another possibility cannot be ignored: that of their use to prepare the surface of retouchers. Attributing the active zones to one or other of these activities (butchery versus preparing retouchers) must therefore take into account data from the analysis of the faunal remains (see Part II, chapter 4.3). Furthermore, it cannot be ruled out that some of these pieces could have been used to work other types of hard organic material, such as very hard wood. Indeed, occasional experiments (see Part I) have shown that edge damage similar to that observed in the working of bone material is sometimes produced when working very hard woods, such as scraping the tip of a point made of fire-hardened wood.

The tools presenting traces of cutting or the percussion of hard organic material were probably used for forceful disarticulation, bone fracturing or opening the thoracic cage.

Furthermore, it seems more likely that the pieces used for piercing hard material were related to the working of wood or even dry, rigid hide (undetermined activity) than to the working of bone material, given that no evidence of this type of transformation of bone or antler has been observed for the period considered.

The working of medium-hard to hard material, totaling 8 % of the active zones, most likely includes pieces that were used in butchery (cutting and percussion) and for the working of hard wood or dry hide (piercing and scraping).

The working of undetermined hard material (organic or mineral) involved a single piece, for which it was not possible to establish an activity.

The percussion of undetermined medium-hard-to-hard material, accounting for 4 % of the active zones and corresponding in fact to 15 flake cleavers, could just as well have been produced by forceful butchery as by woodworking.

Finally, for four pieces, the nature and hardness of the worked material could not be established at all, neither could the activity that they corresponded to.

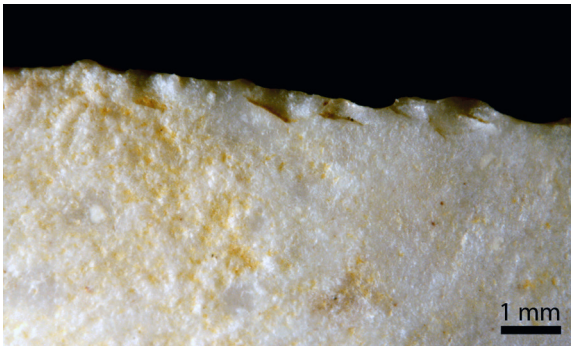
Overall, various activities were identified, even if a significant proportion of the active zones (67) could not be related to a particular activity (table 51, figure 211; Part II, chapter 4).

Butchery activities were the most common, accounting for 279 active zones, i.e. 57 %. The cutting up of carcasses clearly dominated, involving 255 active zones, with 74 pieces presenting the micro-polish characteristic of the cutting up of meat. Some pieces presenting traces of cutting were also used for scraping (26 pieces from Coudoulous). There were 111 zones presenting edge damage typical of butchery, that is to say, the cutting of soft tissue with accidental contact with harder material such as bones or cartilage (cutting of soft to medium-hard material). Sixty four zones presented edge damage from cutting soft material, but with no rounding (cutting of meat rather than hide), and finally, six zones presented numerous large scars that could correspond to heavy butchery involving repeated and intense contact with hard material such as bone or cartilage (figures 172-175). The percussion of carcasses was identified on 22 zones. The macro-traces were comparable to those observed on the experimental tools that served as butcher axes in forceful disarticulation, or to break the ribs at the sternum or the spine. Finally, a small number of pieces presented edge damage that could testify to cutting actions and percussion on the same edge. If we consider the pieces for which an interpretation of the traces could not be established (Annex 5; table 48), the number of active zones reflecting butchery activities could be greatly increased, since 62 additional active zones could have been used for cutting and eight for percussion (Annex 5; table 48). Furthermore, some of the active zones that were used for scraping hard material (41 pieces, i.e. 8 %) could potentially be attributed to butchery activities, but their identification required data to be taken into account from the study of faunal remains at the different sites concerned. Photographs of use-wear traces corresponding or potentially corresponding to butchery activities are available for the different sites in figures 172-175 (cutting), 176-177 (percussion), and 180-181 (scraping). The tools concerned are partly illustrated in figures 217-232 (Part II, chapter 4).

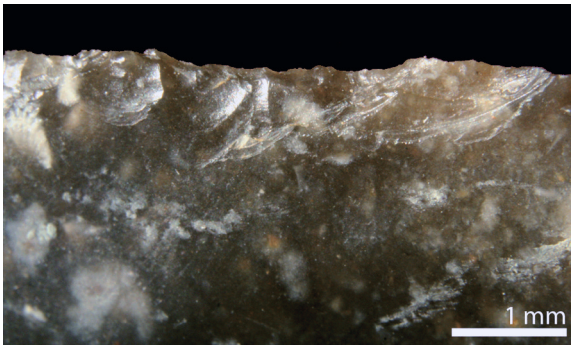
The second most common activity identified was the **working of medium-hard material such as wood**, which represented 14 % of the active zones (68). It should be noted that only 11 pieces, all from Coudoulous, presented the micro-polish characteristic of woodworking, scraping and sawing. The other 57 pieces were attributed to woodworking, based on the characteristics of the edge damage, indicating the working of a material of average hardness equivalent to that of wood (figures 178-179). Longitudinal, transverse and percussion actions were identified, which could correspond to an acquisition stage (percussion or sawing) and the shaping (scraping) of domestic or cynegetic wooden objects. The piercing of wood was not clearly identified and the category "piercing of medium-hard material" probably includes both pieces that pierced wood and pieces that pierced hide. Nevertheless, amongst all the pieces attributed to a piercing action, three pieces appear to have been more likely used for working wood than working hide (Mauran, Les Fieux and Payre). Photographs of the use-wear traces corresponding or potentially corresponding to woodworking are available for the different sites in figures 180-181. The tools concerned are partly illustrated in figures 212-216 (Part II, chapter 4).

Hide working, which involved 34 active zones, only accounted for 7 % of the total number of zones. Almost all the pieces presented micro-polish and micro-rounding characteristic of hide working; only three pieces used for piercing (two) and scraping (one) presented macro-traces alone (figures 176-177). The condition of the hide was difficult to clearly establish. On the one hand, there is a continuum between fresh and dry hide and, on the other hand, a large number of factors could influence the characteristics of the traces such as the possible presence of additives

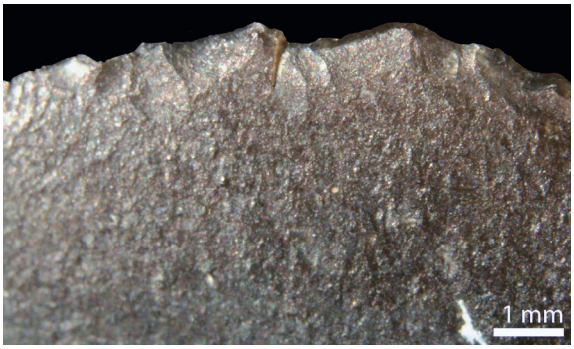
a - Scars produced by cutting a soft to medium-hard materials, Bayonne le Prissé, PM1, flint, unmodified flake (21737)



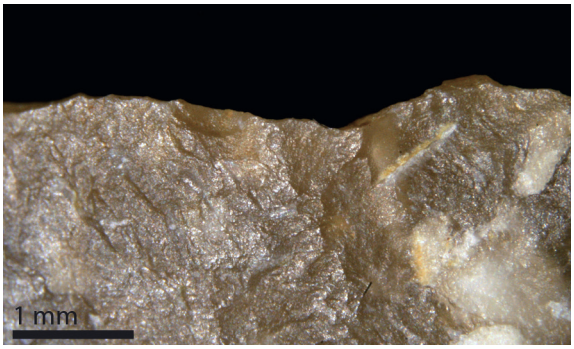
b - Scars produced by cutting a soft to medium-hard materials, Bayonne le Prissé, PM1, flint, biface (22302)



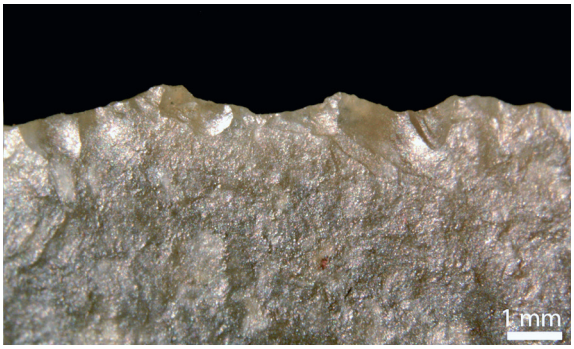
c - Scars produced by cutting tough meaty materials, Chez-Pinaud, flint, pseudo-Levallois point (CPN E16 538)



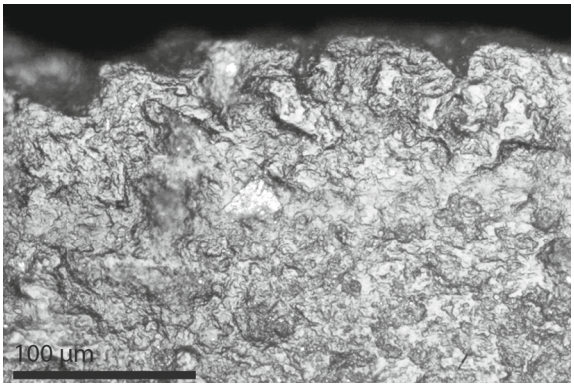
d - Scars produced by cutting a soft material, Chez-Pinaud, flint, biface manufacturing flake (CPN E15 164)



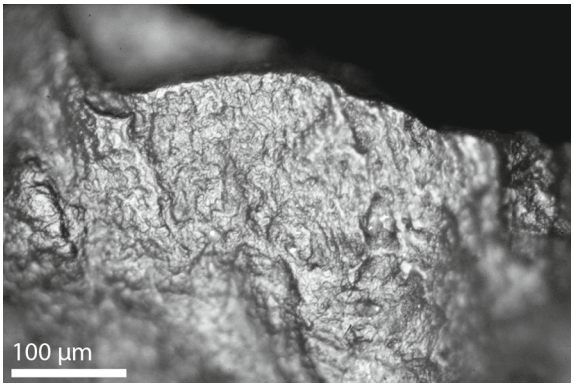
e - Scars produced by cutting a soft material, Chez-Pinaud, flint, biface (CPN E19 374)



f - Scars produced by cutting a soft to medium-hard material, Chex-Pinaud, flint, side-scraper (CPN F15 239)

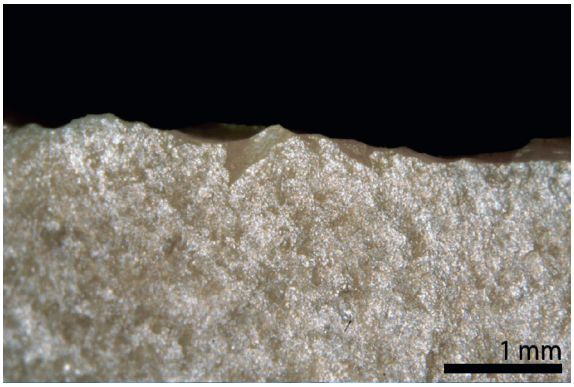


g - Micro-polish produced by cutting meaty or cutaneous materials, Chez-Pinaud, flint, unmodified flake (CPN E15 357)

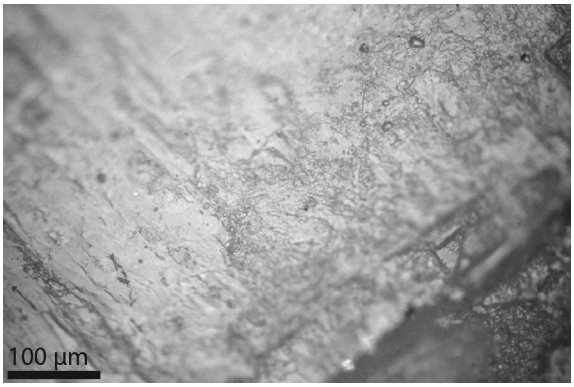


h - Micro-polish produced by the cutting of meaty material, flint, biface (CPN E15 324)

Figure 172 - Macro- and microscopic use-wear traces attributed to butchery, resulting from cutting meat, soft and soft to medium-hard material, observed on the lithic pieces from Bayonne le Prissé and Chez-Pinaud (photographs: É. Claud).

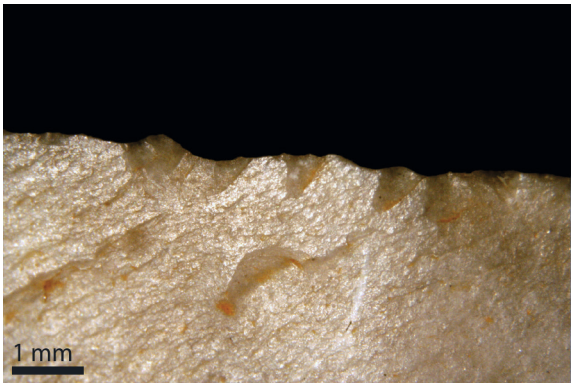


a - Scars produced by cutting a soft material, Combe Brune 2, flint, biface (CB 2 06 61010)

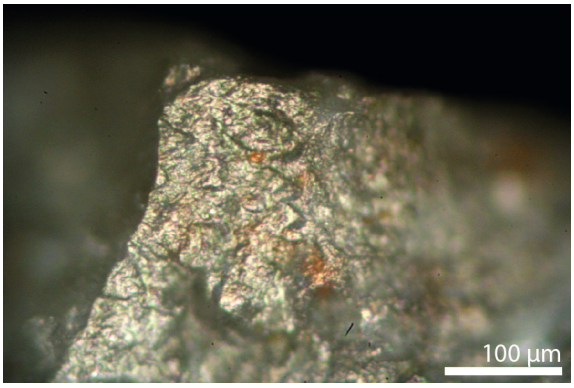


b - Erosion and striations related to butchery, Coudoulous, quartz (Cou 4 #65)

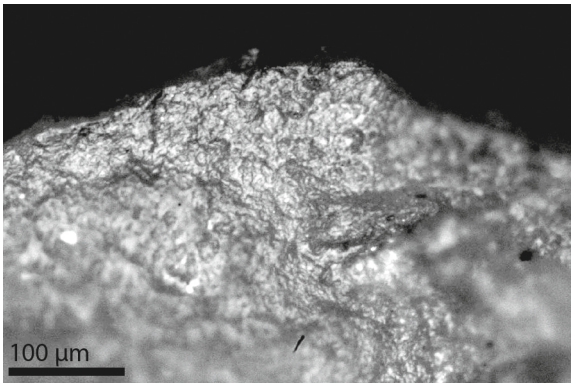
c - Erosion and striations related to butchery (cutting and scraping), Coudoulous, quartz (Cou I J10 6b 6)



d - Scars produced by cutting tough meaty materials, Fonseigner, side-scraper (Fons 77 22 Dsup 13)

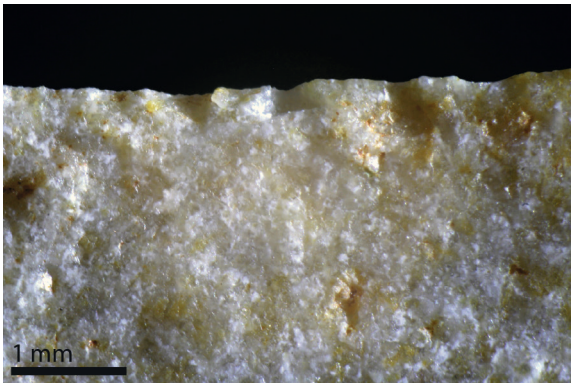


e - Micro-polish produced by cutting meat, Fonseigner, flint, biface (Fons Dsup 32)



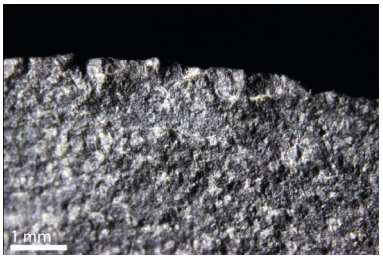
f - Micro-polish produced by cutting tough meaty materials, Fonseigner, side-scraper (Fons 77 A5 65 Dsup)

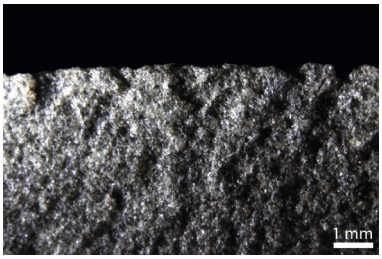
Figure 173 - Macro- and microscopic use-wear traces attributed to butchery, resulting from cutting soft material and meat, observed on the lithic pieces from Combe Brune 2, Coudoulous and Fonseigner (photographs a, d-f: É. Claud; b-c: F. Venditti).



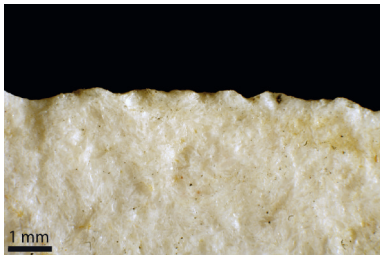
a - Scars produced by cutting a soft to medium-hard material, Les Fieux, flint, unretouched point (K35610, dorsal surface)

b - Scars produced by cutting a soft to medium-hard material, Les Fieux, flint, unretouched point (K35610, ventral surface)



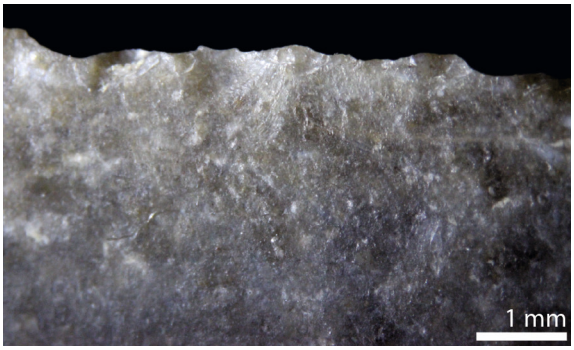


c-d - Scars produced by cutting a soft to medium-hard material, Grotte du Noisetier, schist (c), quartzite (d), unmodified flake (c: NS 13 E11 c1 142; d: NS 05 D13 c1 134)



e - Scars produced by cutting a soft to medium-hard material, Mauran, flint, denticulate (M81 SV 118, ventral surface)

Figure 174 - Macro- and microscopic use-wear traces attributed to butchery, resulting from cutting a soft to medium-hard material, observed on the lithic pieces from Les Fieux, Grotte du Noisetier and Mauran (photographs a-b, e: A. Coudenneau; c-d: É. Claud)



a - Scars produced by cutting a soft to medium-hard material, Saint-Césaire, unmodified flake (H6 (IV) Egpf 29)

b - Scars produced by cutting a soft to medium-hard material, Saint-Césaire, flint, unmodified flake (I5 (I) Egpf 27)

c - Scars produced by cutting a soft to medium-hard material, Saint-Césaire, flint, denticulate (G5 (II) Egpf 27 269-76-73 3)

d - Scars produced by cutting a soft to medium-hard material, Saint-Césaire, flint, denticulate (F6 (IV) Egpf 29 30 285-43-48 9)

Figure 175 - Macro- and microscopic use-wear traces attributed to butchery, resulting from cutting soft to medium-hard material, observed on the lithic pieces from Saint-Césaire (photographs: É. Claud).

(ash, mineral pigments, ...) and the types of supports that may have been used (ground, stones, wooden frames..., Unrath *et al.*, 1986; Gassin, 1996). However, differences in the brightness and extent of the polish and in the intensity of rounding could reflect the working of hides in different states: dry hide at Grotte du Noisetier, dry hide and intermediate hide at Coudoulous and Fonseigner, and fresh or moist hide and intermediate hide at Chez-Pinaud.

Cutting actions dominated, with 21 active zones, followed by scraping, piercing and mixed actions (a combination of cutting and scraping on the same piece). Three bifaces from Chez-Pinaud presenting traces of hide cutting could, according to the characteristics of the traces and the morphology of the pieces, have been used for skinning and thus have been used in a butchery activity, rather than in actual hide working per se. The other pieces used for cutting presented morphological characteristics and wear compatible with either a hide defleshing activity (tangential cutting), the trimming of the edges of the hide, or manufacturing bindings.

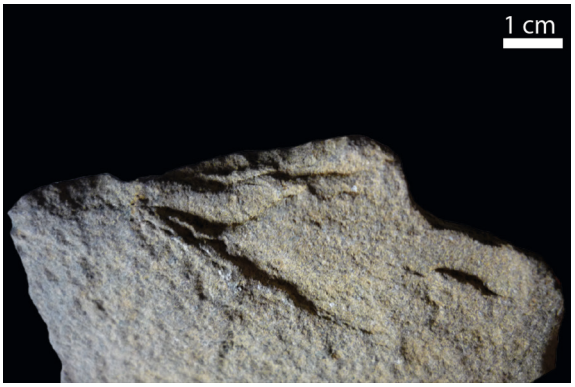
Regarding the pieces used for scraping, it was difficult to relate them to a specific stage in the *chaîne opératoire* of the processing of hide. Nevertheless, the low intensity of wear could be related to a frequent resharpening of the tools, implying a function that required a continually sharp front. Furthermore, the unmodified and sharp nature of most of the working edges (the side scrapers from Fonseigner were particularly used on their unmodified edges, see Part II, chapter 4) seems more appropriate for certain tasks requiring a cutting edge, such as hide defleshing, and thinning, from the inner side of the skin ("drayage") or from the outer side ("effleurage", by scraping or slipping, see Wiederhold, 2004). As for the butchery and woodworking activities, figures are available grouping the use-wear traces related to hide working (figures 182-184) and the tools concerned (figures 235-238, Part II, chapter 4).

Only two pieces were clearly attributed to a **hunting** activity, namely two quartz flakes with impact traces. They are presented in the following chapter, as well as the elements bearing traces compatible with this activity but which were not considered sufficiently diagnostic for us to draw any firm conclusions.

No traces clearly related to the working of non-woody plant material were detected in the assemblages studied.

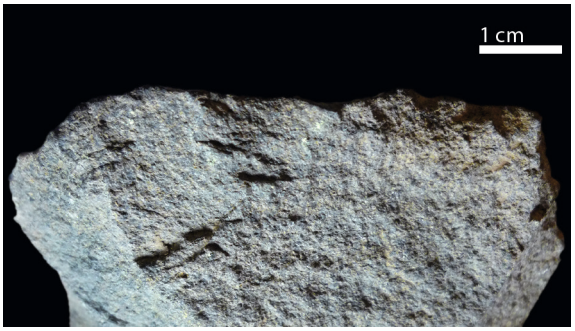
Since the cutting of both wild and cultivated cereals produces characteristic micro-polish, which is well developed (see Part I) and easy to differentiate from natural alterations, it is reasonable to consider that this absence is not related to a taphonomic bias, at least for the best-preserved assemblages or those for which micro-traces were observed. The use of cutting tools is not essential to harvesting edible grain kernels, as they can also be harvested by hand (Harlan, 1992), as can wild, herbaceous plants, which are just as often picked by hand in the ethnographic record (Hayden, 1977; van Gijn, 1989a).

Extracting and treating tubers and roots produces, in principle, traces that are not very distinctive and that are difficult to differentiate from certain natural alterations (Sievert, 1992). However, digging for them in the soil produces intense traces involving very abrasive wear combined with an extremely bright and extensive micro-polish due to the contact with the tubers themselves (Claud, 2008; Beyries *in* Lhomme *et al.*, 1998). It is therefore unlikely that this type of traces would have gone unnoticed in our analyses if they had been present in the assemblages studied. Moreover, in the ethnographic record, cutting tools used for extracting tubers and roots are extremely rare (Hayden, 1977), with digging sticks being preferred.

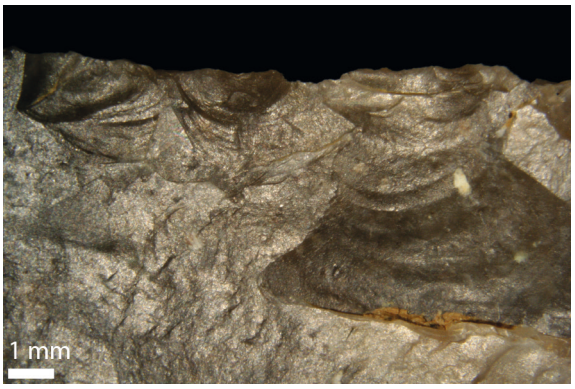


a - Scars produced by percussion against a hard organic material, Abri Olha I, ophite, flake cleaver (no. 2916)

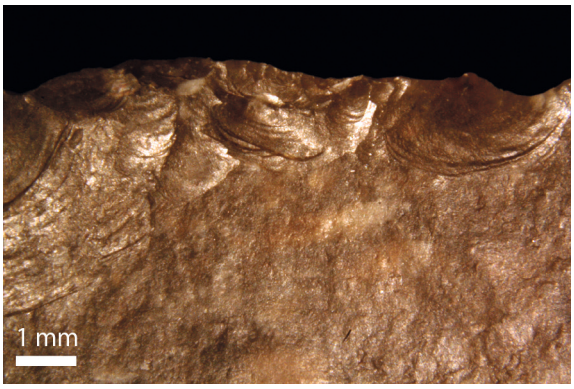
b - Scars produced by percussion against a hard organic material, Abri Olha I, quartzite, flake cleaver (no. 1)



c - Scars produced by percussion against a hard organic material, Abri Olha I, ophite, flake cleaver (no. 2714)



d - Scars produced by percussion against a medium-hard to hard organic material, Chez-Pinaud, flint, side-scraper (CPN D19 928)

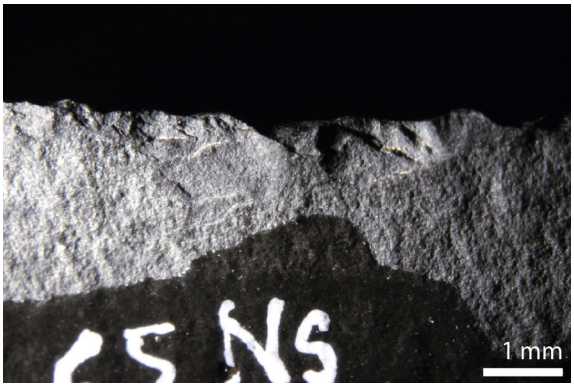


e - Scars produced by percussion against a hard organic material, Chez-Pinaud, flint, naturally-backed knife (CPN E15 63)

f - Scars produced by percussion against a hard organic material, El Castillo, quartzite, flake cleaver (A 112)

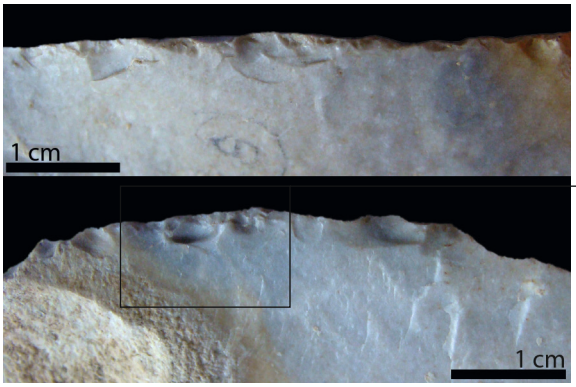
g - Scars produced by percussion against a hard organic material, El Castillo, quartzite, flake cleaver (A 36)

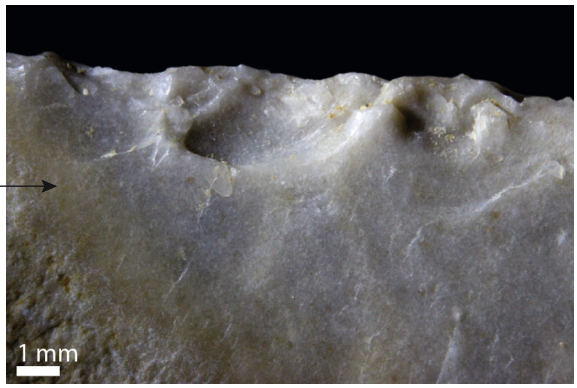
Figure 176 - Macroscopic use-wear traces related to percussion on a hard organic material, probably in the context of butchery, observed on the lithic pieces from Abri Olha I, Chez-Pinaud and El Castillo (photographs: É. Claud).



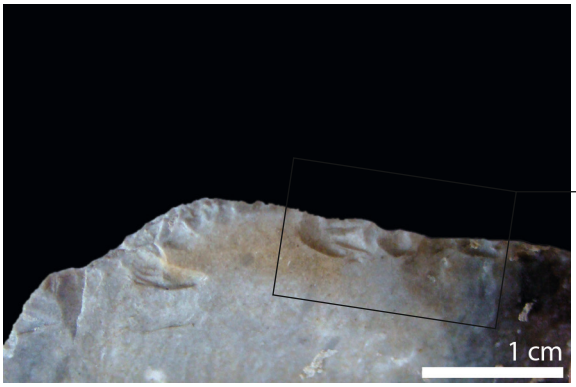
a - Scars produced by percussion against a hard organic material, Grotte du Noisettier, schist, unmodified flake (65NS 16 D 1b 292)

b - Scars produced by percussion against a hard organic material, Les Fieux, flint, denticulate (K 30276)



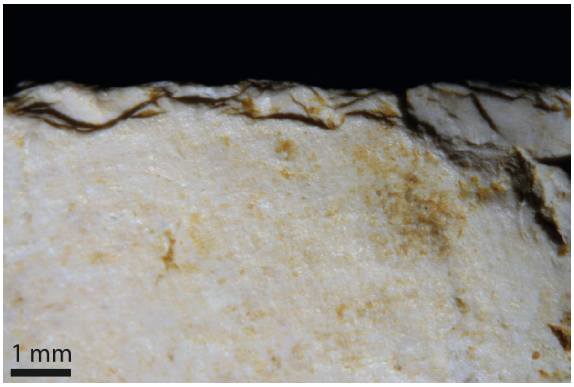


c, d - Scars produced by percussion against a hard organic material, Saint-Césaire, flint, unmodified flake (D7 (I) Egpf 32 33 8)

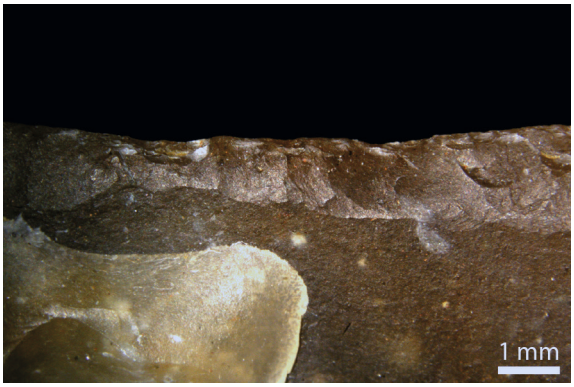


e - Scars produced by percussion against a hard organic material, Saint-Césaire, flint, unmodified flake (H5 (II) Egpf 27)

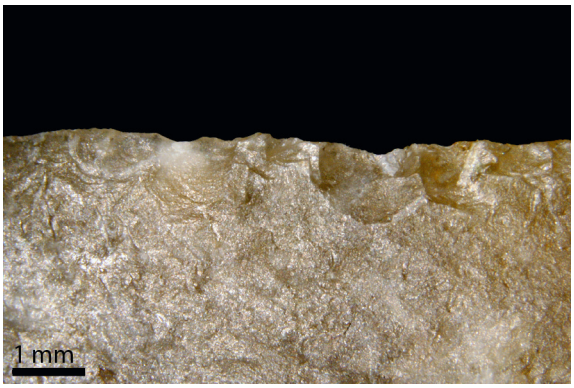
Figure 177 - Macroscopic use-wear traces related to percussion on a hard organic material, probably in the context of butchery, observed on the lithic pieces from Grotte du Noisetier, Les Fieux and Saint-Césaire (photographs a, c-e: É. Claud; b: C. Thiébaut).



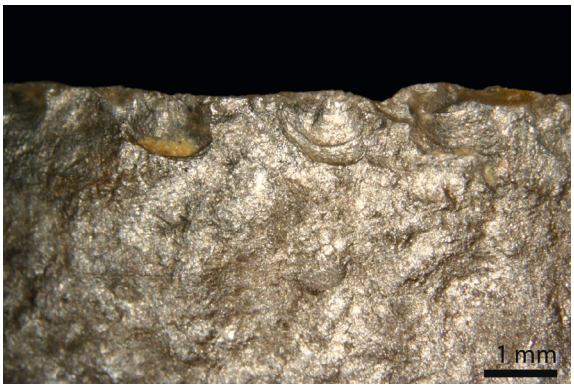
a - Scars produced by scraping a medium-hard to hard organic material, Bayonne le Prissé, PM2, flint, side-scraper (30010)



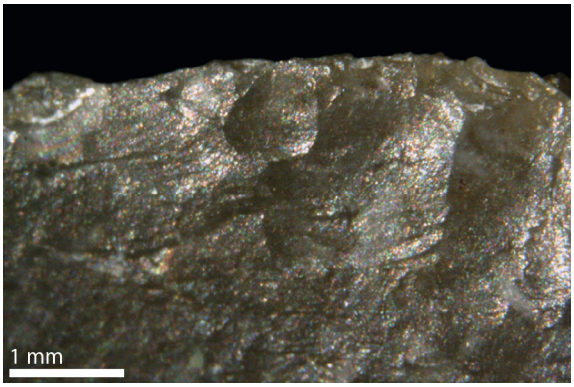
b - Scars produced by scraping a hard organic material Chez-Pinaud, flint, flake (CPN D18-86)



c - Scars produced by scraping a medium-hard to hard organic material, Chez-Pinaud, flint, flake (CPN D19-1422)



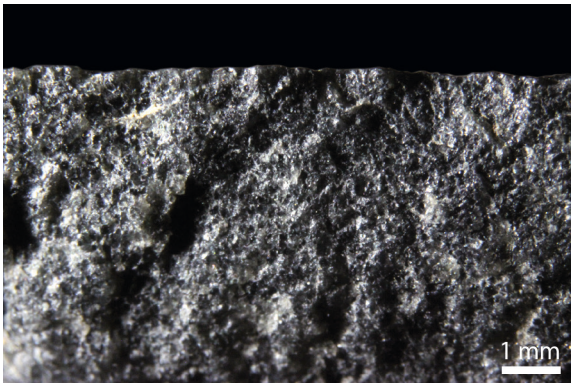
d - Scars produced by scraping a medium-hard to hard organic material, Chez-Pinaud, flint, side-scraper (CPN E12-346)



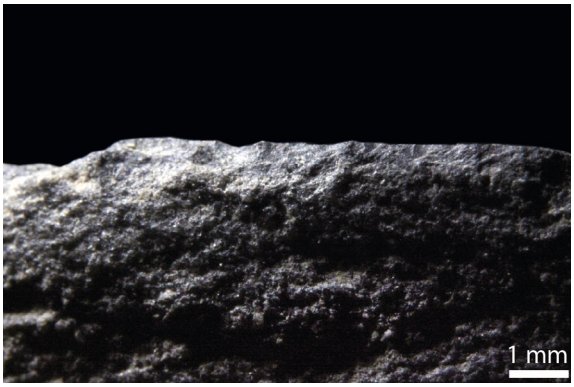
e - Scars produced by scraping a hard organic material Chez-Pinaud, flint, biface (CPN03 D17s47s 5,15-5,20)

f - Scars produced by scraping a hard organic material Fonseigner, flint, side-scraper (Fons 77 Z3 Dsup 03 28)

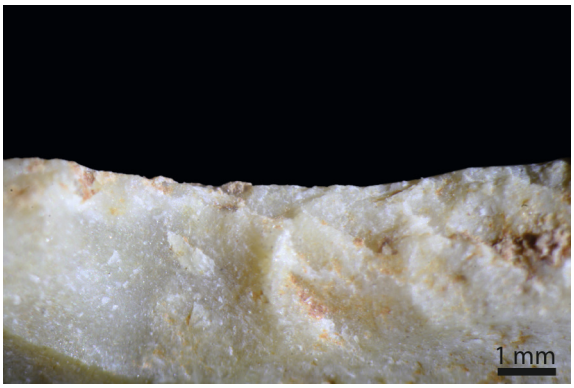
Figure 178 - Macroscopic use-wear traces related to scraping hard or medium-hard organic materials (probable butchery or surface-preparation on retouchers) observed on the lithic pieces from Bayonne le Prissé, Chez-Pinaud and Fonseigner (photographs: É. Claud).



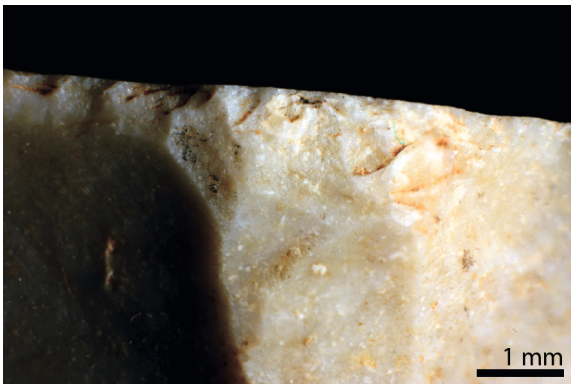
a - Scars of undetermined origin possibly produced by scraping a medium-hard to hard material, Grotte du Noisetier, quartzite, denticulate (NS07 D12 c1 208, dorsal surface)



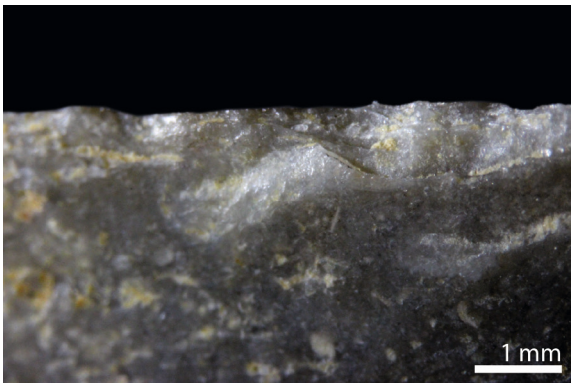
b - Scars of undetermined origin, possibly produced by scraping a hard material, Grotte du Noisetier, quartzite, flake (NS65 D17 c1 160, dorsal surface)



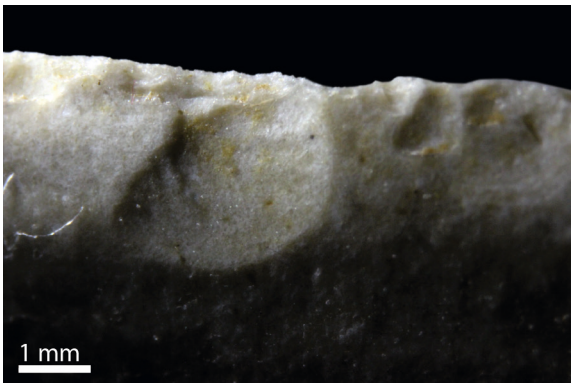
c - Scars produced by scraping a hard material, Les Fieux, flint, pseudo-Levallois point (K32011, dorsal surface)



d - Scars produced by scraping a hard material, Les Fieux, flint, denticulate (K 34280, dorsal surface)



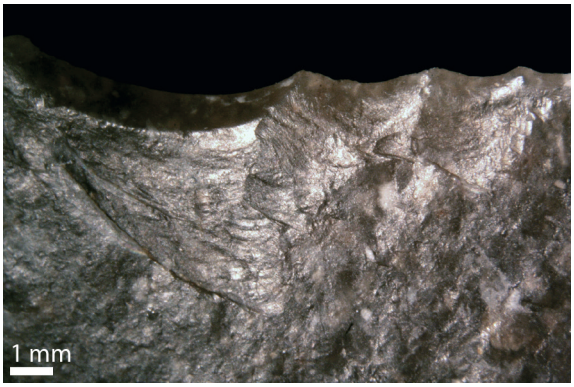
e - Scars produced by scraping a medium-hard to hard organic material, Saint-Césaire, flint, flake (H6 (IV) Egpf 29, dorsal surface)



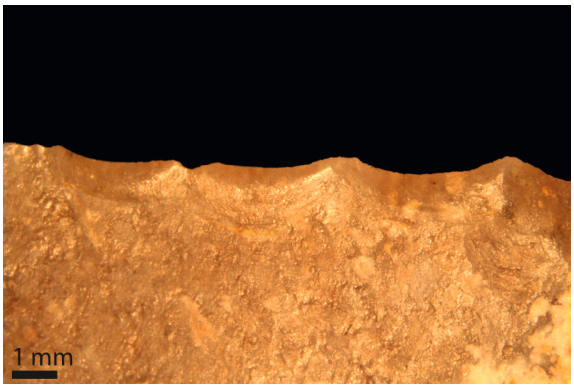
f - Scars produced by scraping a medium-hard to hard organic material, Saint-Césaire, flint, core-edge flake D4 (II) Egpf 27 265 77 79 90, dorsal surface)

Figure 179 - Macroscopic use-wear traces related to scraping hard or medium-hard organic materials (probable butchery or surface-preparation on retouchers) observed on the lithic pieces from Grotte du Noisetier, Les Fieux and Saint-Césaire. Attribution to a specific activity is uncertain for the lithic pieces from Grotte du Noisetier (possible taphonomic convergence) (photographs a-b, d-e: É. Claud; c-d: A. Coudenneau).

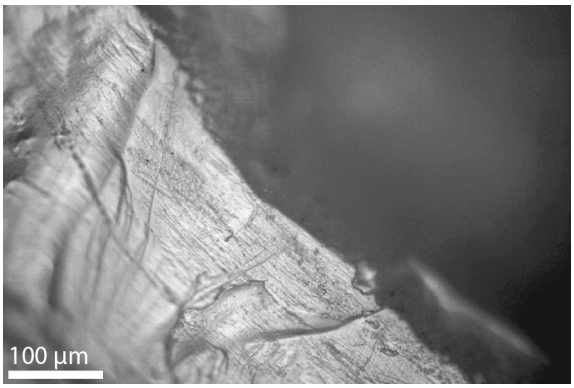
a - Scars produced by percussion against a medium-hard material, Abri Olha 1, ophite flake cleaver (no. 2806, ventral surface)



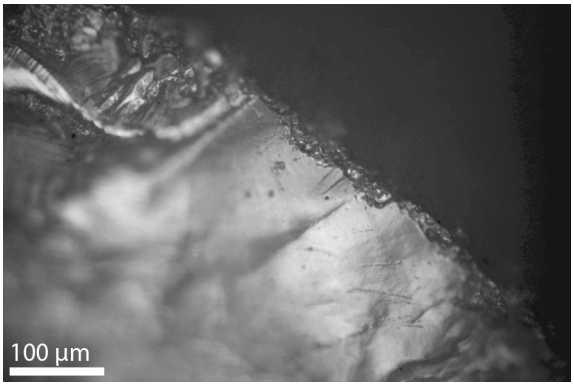
b - Scars produced by percussion against a medium-hard material, Chez-Pinaud, flint side-scraper (CPN D16 912, dorsal surface)



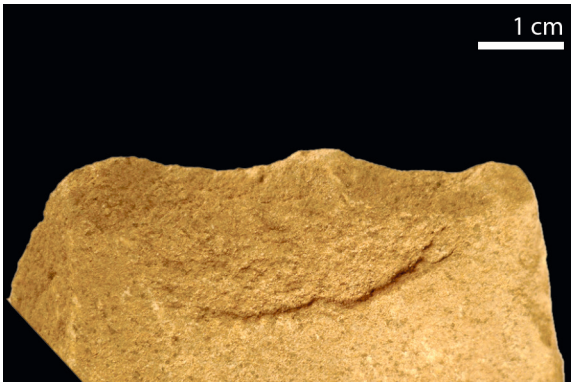
c - Scars produced by a longitudinal action on a medium-hard material, Chez-Pinaud, flint flake (CPN E16 677, dorsal surface)



d - Erosion and striations produced by sawing dry wood, Coudoulous, quartz flake (Cs 79 Ext H8 c4n4 5162)

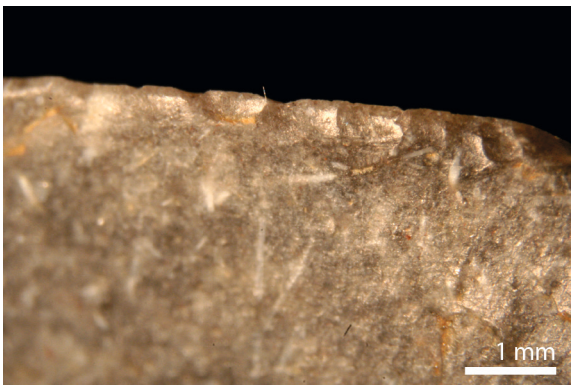


e - Erosion and striations produced by scraping green wood, Coudoulous, quartz flake (COU 79 4 2050)

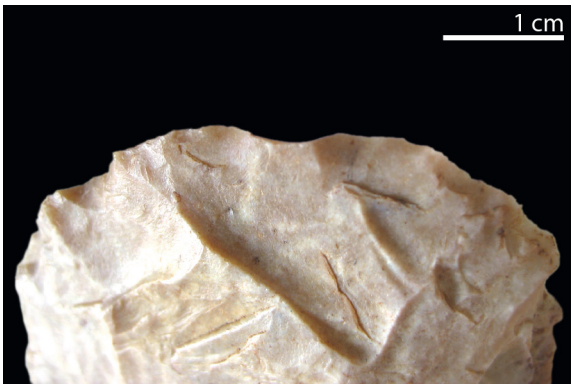


f - Scars produced by percussion against a medium-hard material, El Castillo, flake cleaver (A225, dorsal surface)

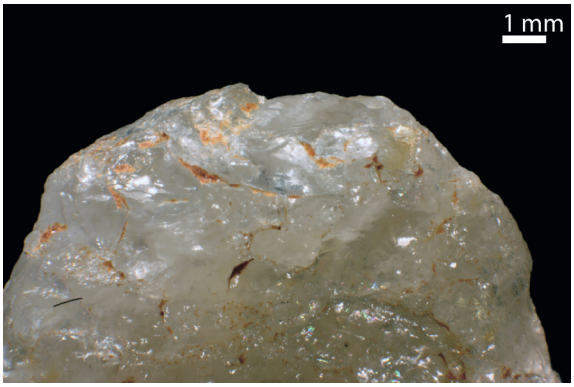
Figure 180 - Macro-and microscopic use-wear traces attributed to woodworking, with certainty (Coudoulous) or likelihood (working of a medium-hard material), observed on the lithic pieces from Abri Olha I, Chez-Pinaud, Coudoulous and El Castillo (photographs: É. Claud).



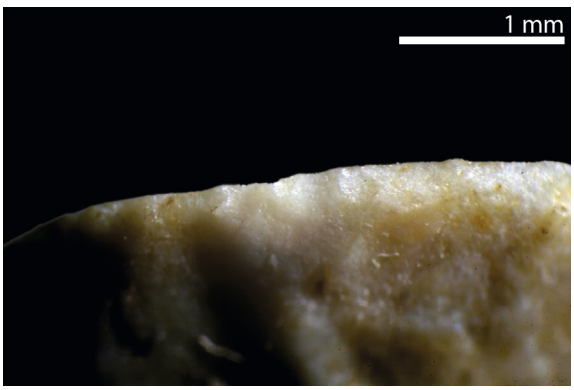
a - Scars produced by scraping a medium-hard material, Fonseigner, flint flake (Fons Z3 Dsup 33, ventral surface)



b - Scars produced by percussion against a medium-hard material, La Graulet, flint biface (1047 dorsal surface)

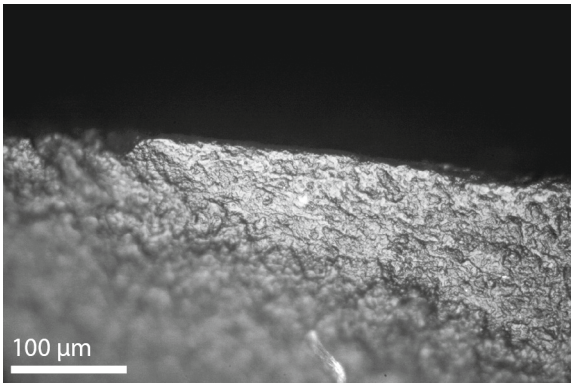


c - Scars produced by punctiform action on a medium-hard to hard material, Les Fieux, quartzite denticulate (K30795, ventral surface)

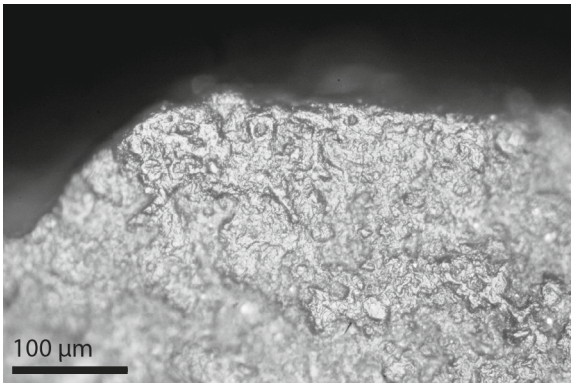


d - Scars produced by scraping a medium-hard material, Les Fieux, flint pseudo-Levallois point (K31356, dorsal surface)

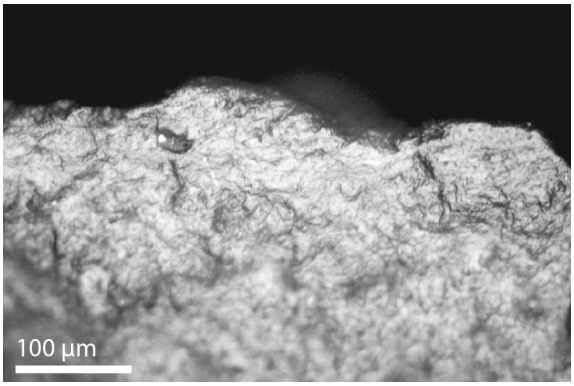
Figure 181 - Macro-and microscopic use-wear traces attributed to probable woodworking (working a medium-hard material) observed on the lithic pieces from Fonseigner, La Graulet and Les Fieux (photographs a-b: É. Claud; c-d: A. Coudenneau).



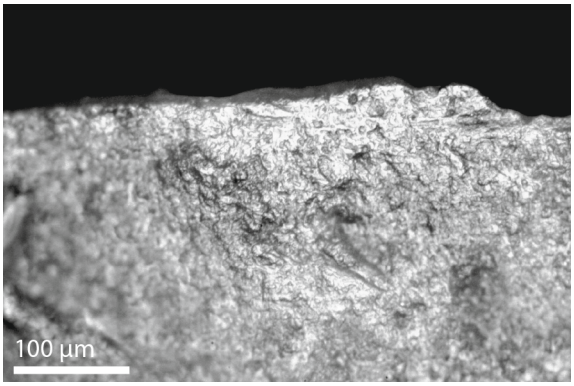
a - Micro-rounding and polish produced by cutting hide, Chez-Pinaud, flint biface (CPN 03 D18 s4 7s 5,5-5,6)



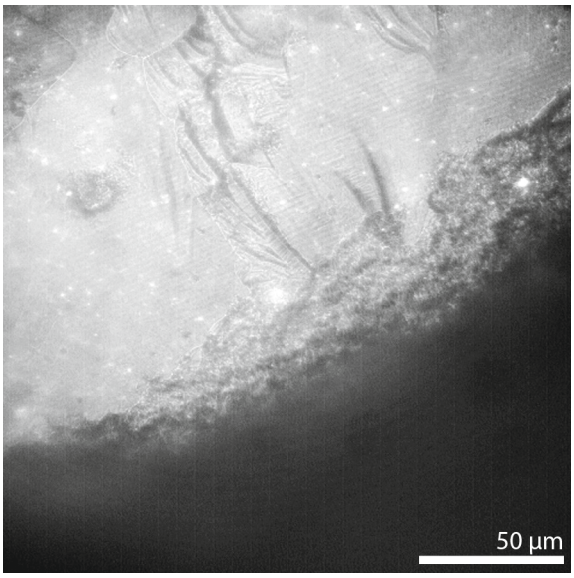
b - Micro-rounding, polish and pitting produced by cutting hide, Chez-Pinaud, flint biface (CPN D16 275)



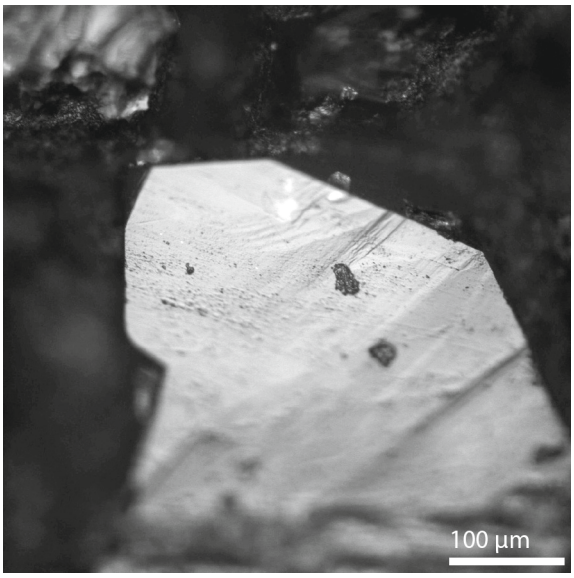
c - Micro-rounding, polish, striations and pitting produced by cutting hide, Chez-Pinaud, flint side-scraper (CPN E16 641, ventral surface)



d - Micro-rounding, polish, striations and pitting produced by cutting hide, Chez-Pinaud, flint flake (CPN E12 800, dorsal surface)

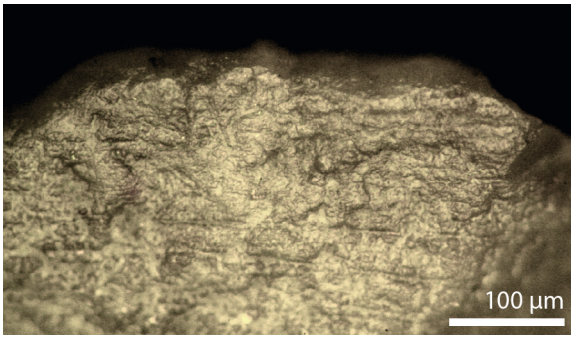


e - Micro-rounding and erosion produced by scraping hide, Coudoulous, quartz flake (CS 79 G9 5102, dorsal surface)

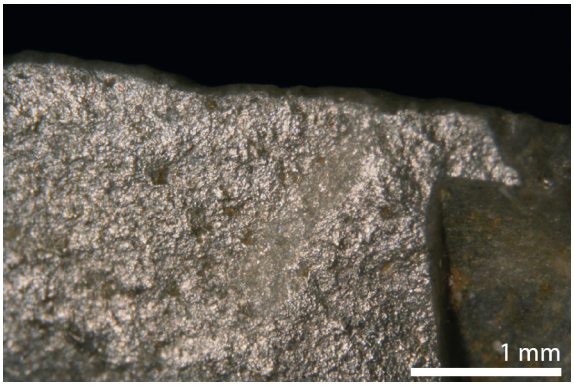


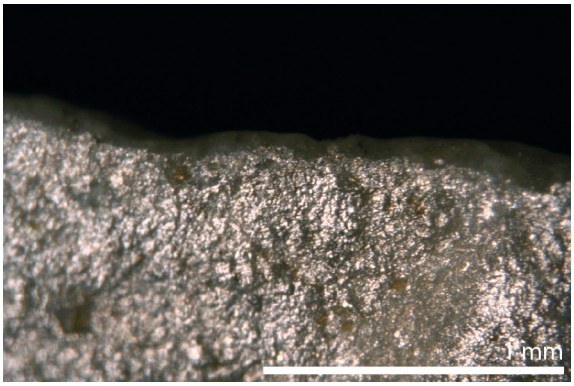
f - Striations and erosion produced by cutting dry hide, Coudoulous, quartz side-scraper (COU I 4 2006)

Figure 182 - Macro-and microscopic use-wear traces attributed to hide working, observed on the lithic pieces from Chez-Pinaud and Coudoulous (photographs a-d: É. Claud; e-f: F. Venditti).

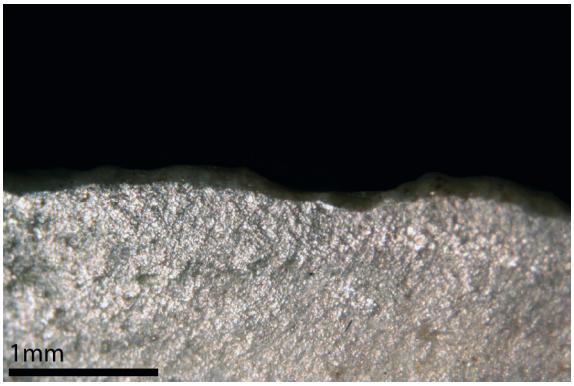


a - Micro-rounding, polish and striations produced by cutting hide, Fonseigner, flint side-scraper (Fons 77 Z1 192 Dsup 19, ventral surface)

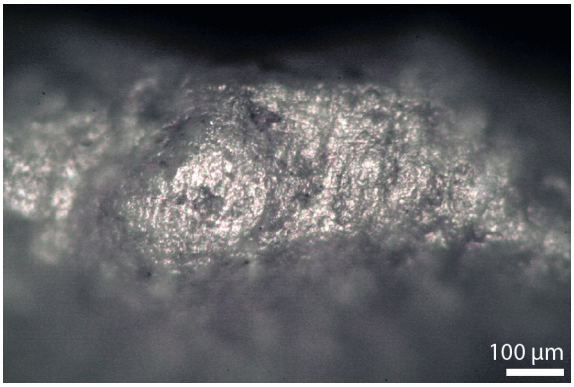


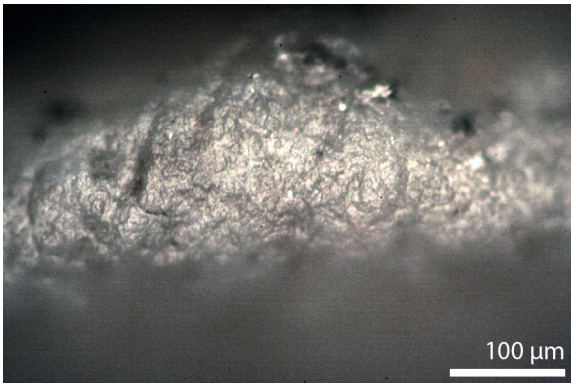


b - Macroscopic rounding produced by scraping a soft abrasive material like dry hide, Fonseigner, flint side-scraper (Fons A4 77 Dsup 26, ventral surface)



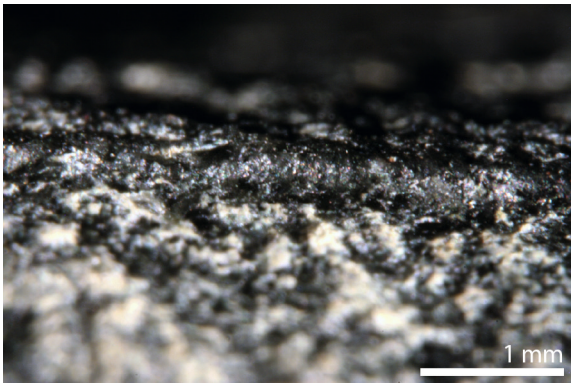
c - Scars and rounding produced by scraping a soft to medium-hard abrasive material like dry hide, Fonseigner, flint side-scraping (Fons 77 A4 85 Dsup 14, dorsal surface at left, ventral surface at right)



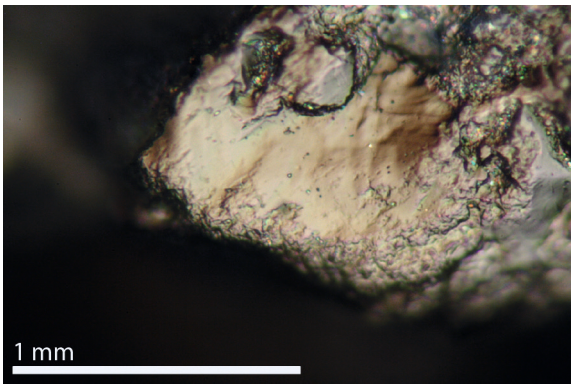


d - Micro-rounding, polish, striations, and pits produced by scraping a soft abrasive material like dry hide, Fonseigner, flint side-scraper (Fons 77 A4 85 Dsup 14, dorsal surface)

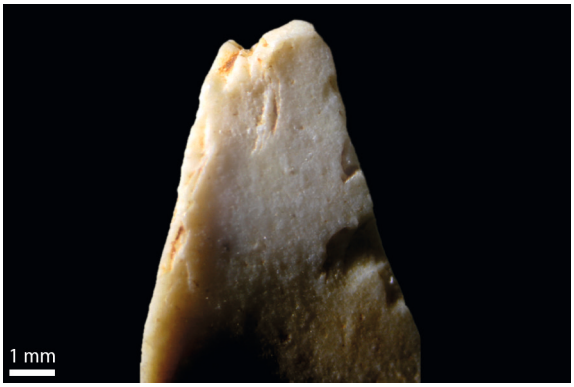
Figure 183 - Macro-and microscopic use-wear traces attributed to hide working, observed on the lithic pieces from Fonseigner (photographs: É. Claud).



a - Macro-rounding produced by scraping a soft abrasive material like dry hide, Grotte du Noisetier, quartzite flake (NS06 C15 c2 147, dorsal surface)



b - Micro-rounding and erosion of a quartz crystal produced by scraping a soft abrasive material like dry hide, Grotte du Noisettier, quartzite flake (NS06 C15 c2 147, ventral surface)



c - Scars and rounding produced by perforating a soft abrasive material like hide Les Fieux, pseudo-Levallois point, flint (K 31712, dorsal surface)

d - Scars produced by perforating a soft to medium-hard material such as hide, Payre, flint flake (PAY LS G5 1174, ventral surface)

Figure 184 - Macro-and microscopic use-wear traces attributed to probable hide working observed on the lithic pieces from Grotte du Noisetier and Les Fieux (photographs a-b: É. Claud; c-d: A. Coudenneau).

3 - The question of points and impact fractures

Despite analyzing many points and pointed elements (flakes and bifaces), pieces identified as potential hunting weapons were rare in our corpus.

Only two pieces from Coudoulous were interpreted as having clearly been used for this type of activity (figure 185). They involved two pointed quartz flakes, each with a step-terminating bending fracture at their distal extremity, as well as abrasive microwear and characteristic striations on their surfaces (figure 185[b-e]).

Wear of uncertain origin but which could also have been produced by this type of function were nevertheless identified at the sites of Chez-Pinaud, Les Fieux and Mauran.

At Chez-Pinaud, a Mousterian point in Turonian flint (non-local) had a burin-like fracture on its distal end, posterior to the retouch, which was 7 mm in length, with a step termination (figure 185[a]). Micro-polish was also present over a 4 cm length on each of the lateral edges, on either side of the point. This indicated longitudinal contact with meat or hide. No scars were associated with these traces. The proximal part of this piece had been thinned by a wide inverse removal. The mesio-proximal part of the lateral edges presented direct, abrupt scars creating a small concavity (figure 187[a]) and semi-circular scarring (figure 187[b]) indicating a possible transverse constraint such as that caused by a haft (see Part I, chapter 2.5). The presence of an apical burin-like fracture has already been used as an argument to conclude the use of certain points as hunting weapons in the Middle Palaeolithic (Villa *et al.*, 2009; Soressi, Locht, 2010; Lazuén, 2012a, 2012b; Rios-Garaizar, 2016). Furthermore, this type of stigma, when it intersects with the retouch, is considered as diagnostic for lithic points from the Upper Palaeolithic (see Plisson, Geneste, 1989; O'Farrell, 2005; Sano, 2009). Nevertheless, during the analysis of the experimental reference collection for points (see Part I, chapter 2.8), burin-like fractures were not retained as characteristic of a hunting-weapon type function. The other elements observed (polish, thinning of the base, and edge damage indicating likely hafting) are however strong arguments in favour of interpreting this piece as an armature. Finally, only its unique character within the assemblage forces us to show caution, if we follow the recommendations of J. Pargeter (2011), for whom a small number of potentially impacted points on a site could be a sign of taphonomic convergence.

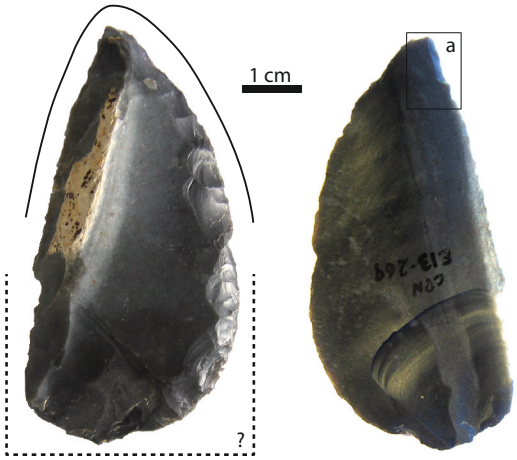
Two flint flakes from Les Fieux also presented possible impact traces. One of them had two bending fractures with a very short languette, the proximal fracture being combined with spin offs of less than 6 mm in length (figure 186[a-b]). On the second flake, a small inverse apical scarring was observed (figure 186[c]). Again, even if these traces are compatible with use as hunting weapons, the absence of any recurrence over a larger number of pieces combined with the fact that these types of fractures can also have natural origins (Pargeter, 2011[1]) incites us to consider them as possible armatures and not confirmed hunting weapons.

A piece from Mauran also presented possible macroscopic impact traces (figure 186). It concerned a quartzite pseudo-Levallois point with a step-terminating inverse bending fracture. It was associated with two continuous quadrangular removals located on the right edge contiguous with the point on the lower face. The fracture alone could perfectly well have been produced during disarticulation in butchery; however, in this case it would be associated with other edge damage.

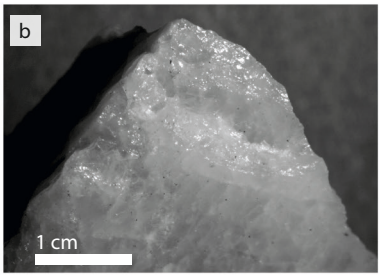
In our corpus, elements interpreted as hunting weapons are rare and often uncertain, their rarity further contributing to this uncertainty, due to the possible convergences of forms, as discussed, in particular by J. Pargeter (2011). This author's recommendations can reasonably be applied here: in the absence of other types of diagnostic traces such as linear microscopic traces (*MLIT*, Odell,

1. "... small spin-off fracture frequencies do occur as a result of trampling and knapping..." (Pargeter, 2011: 2886).

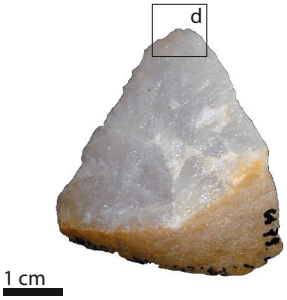
Chez-Pinaud
(photographs: EC)
CPN E13 269, flint
burin removal at the distal end (a)
use: cutting a meaty or cutaneous material and possible hunting arm

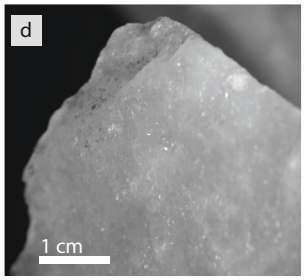


Coudoulous
(photographs: CL)
Cou I 4 1316, quartz
step terminating bending fracture (b) and abrasions and striations (c)
use: hunting arm



Cs 79 F9 c4 n4 5040
quartz, step terminating bending fracture (d) and abrasions and striations (e)
use: hunting arm





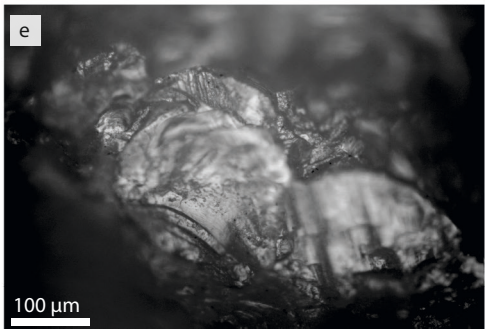
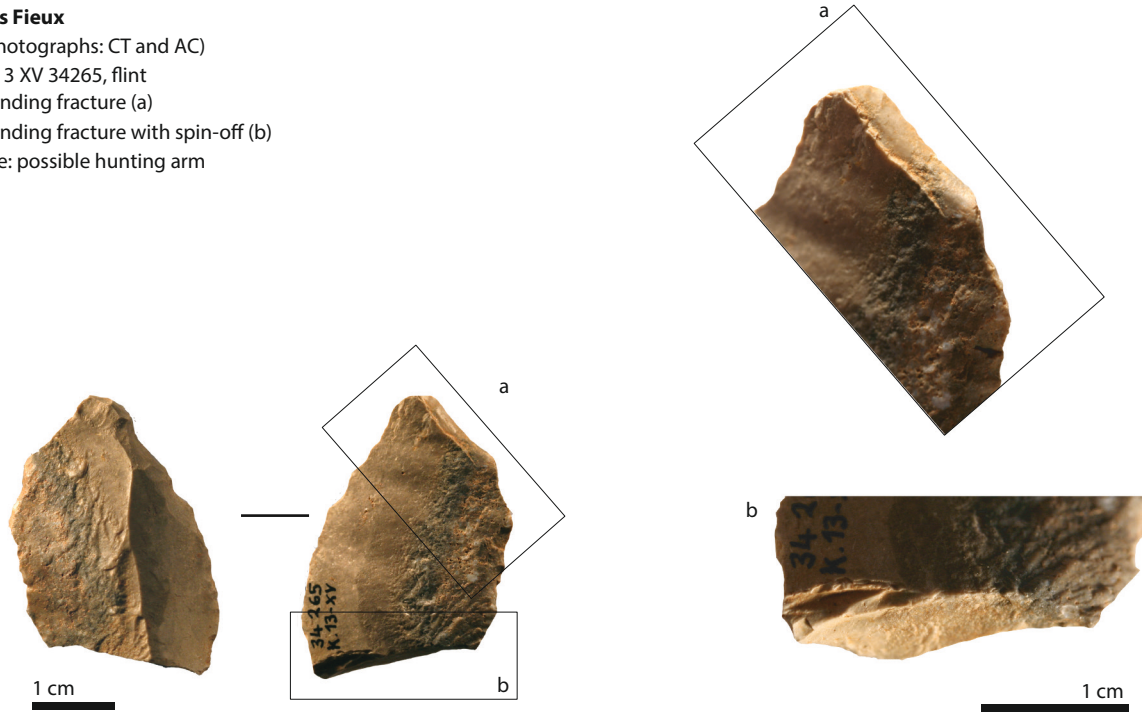
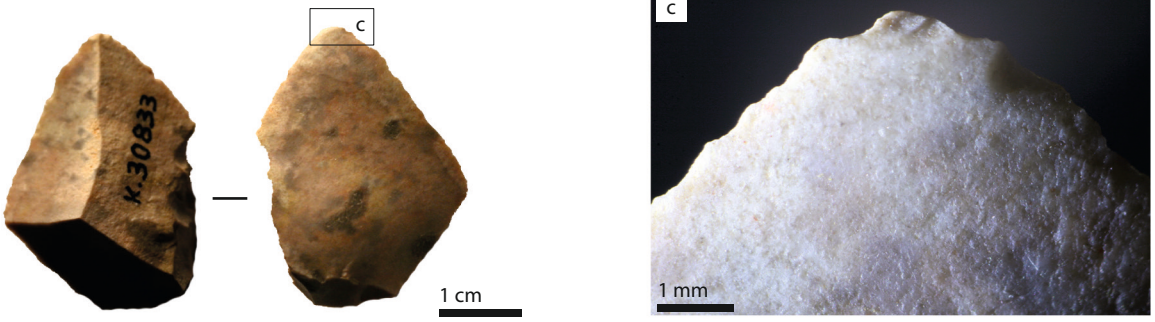


Figure 185 - Pieces bearing damage resulting from (Coudoulous: b-e) or potentially resulting from (Chez-Pinaud: a) use as hunting weapons. The dotted areas indicate the location of possible hafting (CAD: É. Claud and M. Coutureau).

Les Fieux
(photographs: CT and AC)
K 13 XV 34265, flint
bending fracture (a)
bending fracture with spin-off (b)
use: possible hunting arm



K30833, flint
apical scarring (c)
use: possible hunting arm



Mauran
(photographs: CT)
Unmarked object, quartzite
step terminating bending fracture associated
with two quadrangular scars on the right cutting-edge
contiguous with the point, ventral surface
use: possible hunting arm

Figure 186 - Pieces from Les Fieux and Mauran bearing damage resulting from use as hunting arms (CAD: É. Claud and M. Coutureau).

1978; Moss, 1983a), fractures classically considered as diagnostic of an impact must be interpreted with great caution, especially in the case of unretouched blanks, which do not necessarily correspond to the morphology expected for a hunting weapon.

4 - Possible hafting traces

Even if reconstructing prehension methods was not our main objective in our use-wear studies, we were attentive to potential signs indicating the presence of a haft, thanks to our own observations made during the experiments carried out as part of the research project and our own more personal work (Lemorini, 2000; Coudenneau, 2004; Claud, 2008; Coudenneau, 2013). As our reference collection comprised few hafted pieces (unretouched and retouched points, unretouched flakes, bifaces, denticulates, and flake cleavers) and hafting traces were very rare, during the archaeological studies we also took into account the observation and interpretation criteria proposed by V. Rots, based on a large reference collection specific to hafting, composed of replicas of tools from the late Upper Palaeolithic, more suitable reference collections not being available (Rots, 2002a, 2002b, 2004, 2005, 2010, 2015a). V. Rots notably proposes distinguishing alteration traces from hafting traces on the basis of the following characteristics: a clear limit between the hafted zone and the used zone, clearly organized traces (on the edges, ridges, and surfaces close to the edges, the haft limit, or the butt region), frequent polishes and scars, polish distributed according to the micro-topography and without decreasing from the tip of the edge to the inner surface, irregularly sized and grouped scars, and bright spots associated with scarring.

Few of the pieces presented traces compatible with hafting, and if we applied the criteria proposed by V. Rots, hafting was not certain for any of the pieces.

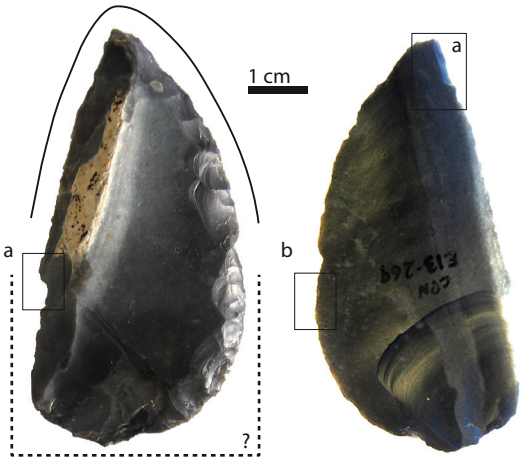
The Mousterian point in Turonian flint presenting a burin-like fracture, from Chez-Pinaud (see Part II, chapter 2.4), is one of the potentially hafted pieces (figure 187): in addition to the thinning of the bulb, its lateral edges present, in the mesio-proximal area, direct abrupt removals creating two small opposed concavities (figure 187[a]). Micro-traces of the cutting of meat or hide, located on either side of the point, develop symmetrically along the edges over a 4 cm surface from the distal end. A clear limit could be observed between these traces and the potentially hafted zone, characterized by the small notches. In addition, several semi-circular scars, with a hinge or step termination, and a perpendicular orientation, were present on the lateral edges, in the proximal area (figure 187[b]). These scars could indicate the existence of a transverse constraint, such as that related to the use of a haft. In the potentially hafted zone, or at its limit with the active zone, no polish or characteristic bright spots (associated with a scar, Rots, 2002a, 2002b) were observed. It should be noted that the assemblage from Chez-Pinaud is not exempt of bright spots of taphonomic origin, which makes this type of trace difficult to use in identifying hafting.

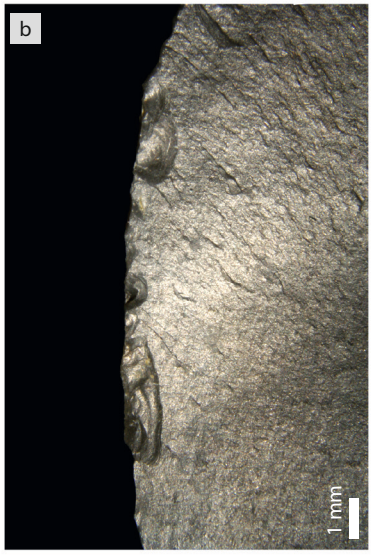
Three flint pieces from Fonseigner, all with converging retouched edges used for cutting meat or hide also presented macro-traces compatible with hafting, in the form of semi-circular, perpendicular scars in the mesio-proximal area (figure 188[a-e]). Unfortunately, there were no associated micro-traces, neither in the form of micro-polish related to contact with a possible haft nor bright spots.

Finally, a quartz flake from Coudoulous, used in butchery, presented abrasive wear on its lower surface probably related to the use of a hide wrapping to hold the tool (figure 187[c]).

No pieces from our corpus presented any macroscopic residues potentially related to hafting (remains of adhesive such as bitumen or birch pitch), which have, in rare cases, been identified in Europe in assemblages from the Middle Palaeolithic (Mazza *et al.*, 2006; Pawlik, Thissen, 2011; Cârciumau *et al.*, 2012). The preservation of such residues requires special conditions that are rarely met for the period considered, so their absence in the assemblages is not significant.

Chez-Pinaud
(photographs: EC)
CPN E13 269, flint
scars perpendular to edge (a, b)
use: cutting of meaty or cutaneous material and possible hunting arm
prehension: transverse constraint (haft?)





Coudoulous
(drawing and photograph: FV)
COU I J106b 6, quartz
micro-abrasion (c)
use: cutting of meat
prehension: contact with hide (sheath, ligature?)

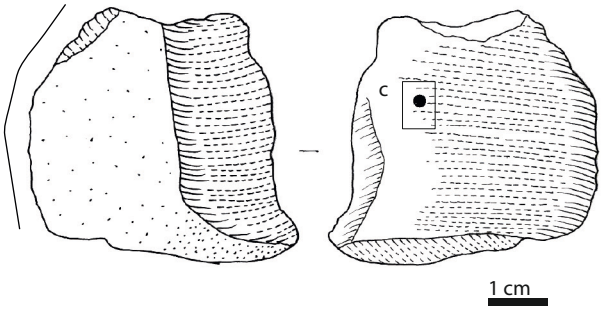
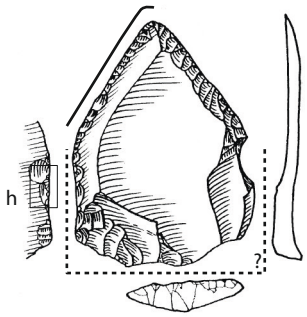
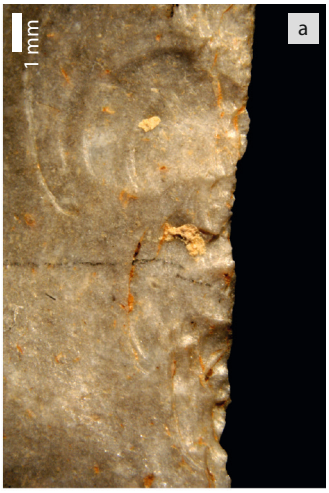


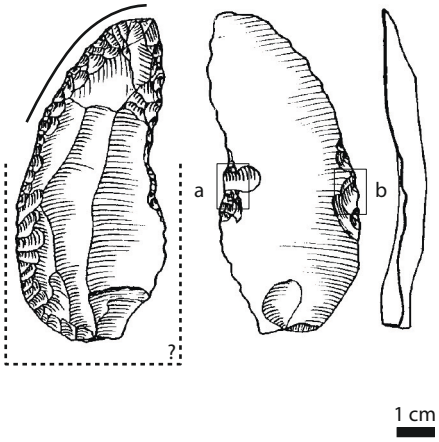
Figure 187 - Pieces from Chez-Pinaud and Coudoulous bearing traces that could indicate prehension: wrapping (c: abrasion) and hafting (a, b: scarring) (CAD: É. Claud and M. Coutureau).

Fonseigner
(drawings: J.-M. Geneste; photographs: EC)
Fons 9 Z1 Dsup 15, flint
scars perpendicular to the edge (a)
use: cutting of hide
prehension: transverse constraint (haft?)





Fons Z3 106 Dsup 9, flint
scars perpendicular to the edge (b, c)
use: cutting of hide or meat
prehension: transverse constraint (haft?)



Fons 3 Z1 Dsup 4, flint
scars perpendicular to the edge (d, e)
use: cutting of meaty material
prehension: transverse constraint (haft?)

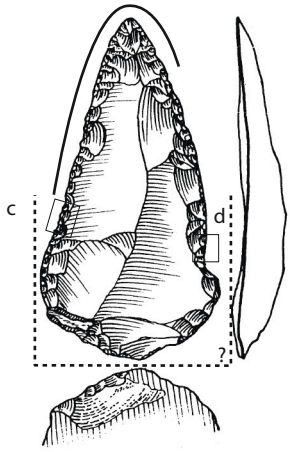


Figure 188 - Pieces from Fonseigner bearing traces that could result from hafting (a-e: scarring) (CAD: É. Claud and M. Coutureau).

During our experiments with different actions, the hafting of some tools proved a hindrance to carrying out certain tasks. Thus, in the case of cutting up carcasses during butchery, the haft could hamper penetration into the flesh, as has also been observed by F. Alhaïque and C. Lemorini (1996). According to these two authors, the usefulness of a haft depends on the butchery stage (efficient for skinning versus inefficient for disarticulation) and the type of joint concerned. In addition, the fluids loosen the bindings, whether they are made of leather or tendons, so it is essential that the bindings are covered with a waterproof protection (glue) or that the tool is fixed without bindings (entered forcefully into the haft, or glued). When scraping hide or wood, the presence of a haft reduces flexibility in the working angle, because the haft sometimes strikes the material being worked, which can be a hindrance for example in scraping with wide positive rake angle (planing). Furthermore, for a haft to be useful, it must be perfectly adapted to the tool and the activity being carried out. The production of certain hafts can therefore take a relatively long time. It can also significantly increase the time required to shape a tool such as a biface in order to render it sufficiently thin so that the haft does not limit the penetration of the working edges into the flesh. If we reason in terms of efficiency, this kind of haft presupposes the high longevity of the lithic pieces or their standardization so that they can be easily replaced. The use of very simple hafts (partially split wooden sticks into which the lithic tool is forcibly inserted at one end) can prove useful for carrying out activities requiring a great force to be applied with a small tool. In the case of the butchery of bison, one of our team thus found that this type of hafting was more effective than simply holding the tool with bare hands and helped avoid excessive tensing of the muscles.

Hafts were extremely useful in tree felling and fracturing thoracic cages by percussion, performed with bifaces, and above all, flake cleavers. Hafts were used that had been little worked: branches of sufficient diameter to create a mortise on the distal end without it losing too much of its solid, robust nature. Only the prehension was therefore thinned. Tree felling and fracturing the thoracic cages was sometimes carried out without hafts, but with much more difficulty (more muscle pain, and a much longer process). Use-wear traces on the active parts were found to be much more intense on the hafted flake cleavers than on those held with bare hands. This observation has allowed us to propose – not on the basis of a use-wear examination of the prehension, but indirectly – the hafting of most archeological flake cleavers presenting use-wear traces related to percussion.

The low number of potentially hafted pieces in our corpus contrasts with the results recently acquired at other sites of the Middle Palaeolithic, which are admittedly situated further north and often older, namely Maastricht-Belvédère, Biache-Saint-Vaast, Bettencourt-Saint-Ouen and Sesselfelsgrotte (Rots, 2014, 2015b). Indeed, at these sites, high quantities of hafted pieces have been announced, ranging from 30 to 60 % (Rots, 2014). These rates are slightly lower if we take into account the fact that the degree of certainty attributed to the interpretations varies (from 0 – uncertain – to 4 – certain). Thus, depending on the site, 8 to 41 % of the pieces are considered to have been hafted with certainty, and on all the sites around 20 % of additional pieces were possibly hafted (Rots, 2015b). The hafted pieces were used as hunting weapons, butchery knives, for woodworking (percussion and scraping), and for scraping and piercing undetermined materials. According to V. Rots, hafting appears to have been a little less frequent for tools used for cutting than for those used for scraping and percussion. She also remarks that the more frequent an activity was on a site, the greater the likelihood that the tools used for the activity were hafted.

It is worth questioning the origin of this difference in frequency between our data and the results recently acquired for these sites. Is the origin methodological, taphonomic, or does it reflect differences in human behaviour?

We know that the same criteria were used for assessing the material, because we applied the interpretation framework proposed by V. Rots herself. Although we are less experienced in recognizing hafting traces, this aspect alone cannot explain such a difference. It is also possible that we were too cautious or rigid in applying V. Rots' interpretation criteria, seeking to observe a very large body of evidence, including characteristic micro-traces. Some pieces that we considered as possibly hafted would perhaps have been interpreted as definitely hafted by V. Rots.

V. Rots studied only a sample of retouched tools from the assemblages from Maastricht-Belvédère, Biache-Saint-Vaast and Sesselfelsgrotte, and some of the Levallois points from Bettencourt-Saint-Ouen. Such a sampling, which differs from a global analysis in that if focuses on the pieces most likely to have been hafted, significantly increases the proportion of hafting traces.

Most of our assemblages had suffered from natural alterations of varying intensity (see table 47) which could have obliterated some traces related to hafting or complicated their interpretation, but the assemblages studied by V. Rots were not free of alterations either, and the microscopic approach was not always possible (Rots, 2015b). According to V. Rots, the organization of the traces was so clear on some pieces, that even though they had undergone alteration (patination but not scarring), it was still possible to interpret them. Thus, the presence of micro-traces was not essential to identify hafting, while their absence incited us to be cautious in our interpretations.

Finally, behavioural differences could potentially play a role in the difference in frequency of hafted pieces. It is not impossible that the Neanderthal groups of southwest France hafted their tools less frequently than those occupying more northerly regions or that they hafted them differently, using techniques that left little or no traces. Indeed, the use of adhesives limits the development of traces because it reduces friction between the tool and the haft or bindings (Rots, 2002a, 2002b). Thus, sometimes experimental hafted pieces have not shown any traces that can testify to their prehension mode (Rots, 2002a; Claud, 2008). Differences in the types of glue used could also potentially influence the possibilities for identifying hafting. V. Rots used resin in her experiments, but other adhesives could have been used too, such as birch pitch, bitumen (found archeologically in the form of residues), animal glue. If the hypothesis of behavioural differences between the groups of southwest France and the more northerly groups can be put forward to explain a difference in the frequency of hafting traces, this does not necessarily imply any behavioural homogeneity amongst these groups, which are, chronologically speaking, sometimes very distant (see Bettencourt-Saint-Ouen and Maastricht-Belvédère). Indeed, if a common factor could explain the low quantity of hafting traces in a given region (use of one type or several adhesives, in particular, for example), it is not sufficient to characterize the complexity of the hafting systems potentially used by the different groups.

Other experiments with hafting, using replicas of Middle Palaeolithic tools, as well as the discovery of new sites presenting assemblages whose state of preservation is suitable for use-wear analysis, or even the analysis of organic residues, would allow us to advance further on this issue.